THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 48. Thursday, March 9, 1933. No. 864.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial: 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, the Advertisement Manager, or the Publisher of

THE FOUNDRY TRADE JOURNAL,
49, WELLINGTON STREET, LONDON, W.C.2.

Telegraphic Address: "Zacatecas, Rand, London."
Telephone: Temple Bar 3961 (5 lines).

Contents.

	PAGE
Forthcoming Events	169
Cast-Iron Roads and Pavements	169
The Business End of Research	169
Correspondence	170
Influence of the Carbon Content on the Structure of Grey Cast Iron	170
Random Shots	170
Sand Testing in the Foundry	171
Does Science Help the Foundry Industry?	174
Making a Chemical Pan	176
Phosphorus in Low Total Carbon Cast Irons	177
Training Foundry Salesmen	179
Catalogue Received	179, 182
Chicago Convention	180
The "New Manchester" Saw	180
This Week's News in Brief	182
Trade Talk	182
Obituary	182
Personal	182
Company Meeting	182
New Companies	182
Company Reports	182
Raw Material Markets	184

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

Institute of British Foundrymen.

PRESIDENT: 1932-33:

Victor Stobie, M.I.E.E., Langholm, South Drive, Harrogate.

LIST OF SECRETARIES—

General Secretary: T. Makemson, Saint John Street Chambers, Deansgate, Manchester. London Office: 49, Wellington Street, London, W.C.2.

Birmingham, Coventry and West Midlands: L. W. Bolton, 21-23, St. Paul's Square, Birmingham.

Sheffield: T. R. Walker, 33, Ladysmith Avenue, Nether Edge, Sheffield.

Scottish: J. Bell, 60, St. Enoch Square, Glasgow.

Lancashire: J. E. Cooke, 1, Derbyshire Crescent, Stretford, Manchester.

London: H. W. Lockwood, Stewarts & Lloyds, Limited, Winchester House, Old Broad Street, London, E.C.2.

Newcastle-upon-Tyne: J. W. Eckford, 4, Mosley Street, Newcastle-upon-Tyne.

East Midlands: H. Bunting, 82, Otter Street, Derby.

West Riding of Yorkshire: S. W. Wise, 110, Pullan Avenue, Eccleshill, Bradford.

Wales and Monmouth: J. J. McClelland, 12, Clifton Place, Stow Hill, Newport, Mon.

Middlesbrough: F. A. Harper, "The Briars," Bishopton Road, Stockton-on-Tees.

Foundry Trades' Equipment and Supplies Association.

President: D. H. Wood.

Titan Works, Charles Henry Street, Birmingham.
Secretary: K. W. Bridges, Grand Buildings, Trafalgar Square, London, W.C.2.

Welsh Engineers' and Founders' Association.

Secretary: E. J. Griffiths, 2, Royal Metal Exchange, Swansea.

BRITISH CAST IRON RESEARCH ASSOCIATION

The Registered Office and Laboratories of the B.C.I.R.A. at:—
21-23, ST. PAUL'S SQUARE, BIRMINGHAM.
Telephone: Central 1885. Telegrams: CIRA.
The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk (Telephone 332)

Forthcoming Events.

MARCH 13.

Royal Society of Arts:—Lecture, "Welding and Allied Processes for Engineering Purposes," by Arthur Stephenson

MARCH 15.

Institution of Welding Engineers:—Ordinary meeting. "A General Survey of Metallic Arc-Welding, with Particulars of Some Welded Products," Paper by D. G. Sinfield.

Institute of British Foundrymen.

MARCH 10.

Middlesbrough Branch:—Ordinary meeting. "Rotary Furnaces in the Modern Foundry," Paper by W. Scott.

Birmingham, Coventry and West Midlands Branch:—Ordinary meeting at Birmingham. "The Production of Sand-spun Pipes," Paper by J. B. Allan.

MARCH 11.

Scottish Branch:—Ordinary meeting at Edinburgh. "Modern Metals in the Brass Foundry," Paper by John Arnott.

MARCH 18.

Lancashire Branch (Junior Section):—Ordinary meeting at Manchester. "Modern Patternmaking," Paper by W. Stafford.

Wales and Monmouth Branch:—Annual general meeting at Cardiff.

Cast-Iron Roads and Pavements.

We have referred previously to the possibilities of cast-iron blocks for road construction. They offer an extremely promising outlet for a considerable tonnage of material and one which represents a new departure so far as cast iron is concerned. It is inevitable that a considerable time should elapse before a considered verdict is obtained because a long trial period is necessary before a stretch of cast-iron road can be adequately compared with the more usual forms of construction. The reports available so far, however, show that a number of authorities have laid down lengths of cast-iron roads in various places to work under varying conditions. The better the material serves its purpose the longer it will be before its useful life is reliably known.

We also notice with interest that the general building plans for the new Roman Catholic Cathedral at Liverpool have been announced. The architect, Sir Edwin Lutyens, says that he is reluctant to use for a permanent building materials which are innocent of long experience, and for that reason he has ruled out a reinforced structure, since he regards steel and cement with widely-differing expansions and contractions as liable to ultimate destruction by vibration. The Cathedral will cover 300,000 sq. ft. and it is proposed that the main floor shall be paved with cast iron, beautiful in its dark silver reflecting colour, and easy to warm. It would be interesting to know whether this is an independent choice on the part of the architect, or whether it represents skilful salesmanship on the part of those concerned with the production of cast-iron blocks for highway purposes. Cast iron to-day, like wrought iron, is not used to anything like the extent it was at one time for building purposes, partly because modern taste has so radically changed from that which demanded the more involved artistic forms to which both cast and wrought iron so readily lent themselves. The above proposal, however, reminds us that cast iron can be produced just as well in the straight-line forms used to-day, if not better than in the curves of a past generation.

It is probable that the economy campaign which has resulted in restricting the general building programmes of the local authorities will hinder road development as much as house building, etc., but we look forward with confidence to the establishment of cast iron as a road material, amply justified on grounds of cost, suitability and convenience. If it facilitates the more speedy making of roads the transport community will have every reason to bless its advent.

The Business End of Research.

We were forcibly reminded by the publication of the Annual Report of the Department of Scientific and Industrial Research that the associations operating under their auspices have such mundane matters as money and business to worry about.

"It has always been our policy," says the report, "to encourage Research Associations to become self-supporting at the earliest possible opportunity, and, in considering the claims of each Research Association for the continuance of State aid we have endeavoured to secure that the Department's grants should be conditional upon the maximum effort being put forth by the industry concerned.

"We have given some consideration to a suggestion that Research Associations would be greatly assisted towards a stable financial position if an Enabling Act could be passed by Parliament giving statutory authority for raising funds from industry for purposes of industrial research by means of a compulsory levy on raw material, output, or some other convenient basis of assessment. Clearly, however, before such a measure could be applied to a particular industry, it would be necessary to show that a substantial majority of the firms in the industry were in favour of the compulsory principle. We deemed it wise to ascertain, through the Research Associations, whether the industries they severally represent were in favour of action on these lines, and whether the number of industries likely to take advantage of the powers that would be conferred by such a measure would justify fuller consideration of the proposal. The replies of the great majority of Research Associations were, generally speaking, unfavourable to the compulsory principle, the general trend of opinion being that, if firms could not be induced in their own interests to support Research Associations, there was little to be gained and possibly something to be lost by compelling them to do so. The replies further indicated that the existing members of Research Associations greatly appreciate the wide powers

they enjoy at present in the exercise of their autonomy, and that some of them feared that, if Research Associations came under the operation of a statutory order, their liberty of action would be jeopardised, the personal interest of the more enthusiastic members would wane, and the Research Associations would rapidly find themselves out of touch with industry.

". . . . We are not prepared, at the present time at all events, to make any representations with a view to the introduction of a general measure in Parliament to authorise the compulsory adoption of a levy. We should welcome any scheme brought forward by a Research Association to place its finances on a sound footing by voluntary effort on the part of the industry, and if an individual Research Association should succeed in procuring the introduction of a Bill in Parliament to make a levy compulsory, we hope that it will receive full support from the industry concerned."

Before the foundry industry tackles the problem of whether it should or should not sponsor a compulsory levy Bill, there are two matters which need prior attention. One is that the associations should possess capital in addition to income, as there are innumerable difficulties attendant on the purchase of really expensive apparatus from income. The second is that a better lead should be given from the Department as to the Patent situation, especially the position research associations should assume for the commercial development of patentable processes. It appears to us that there should be formed in conjunction with each association a commercial company, any profits from which would be returned to the Association. It should be borne in mind that an invention may be made of such far-reaching importance that its commercialisation may be greater than the financial and personnel resources of a Research Association could adequately withstand. Or, again, certain developments may cover processes or plant of a competitive character, when exploitation by commercial interests is simpler and, to our mind, preferable.

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

Small Chilled Rollers.

To the Editor of The Foundry Trade Journal.

Sir,—Referring to the inquiry on the above subject, printed in The Foundry Trade Journal of February 9, I have pleasure in giving your correspondent my experience in overcoming his difficulty. I presume he is using permanent moulds, and would suggest that the mould is being used too often without making a change.

When a mould has been used for some time, the carbon is burnt off from the face, and then there is difficulty in getting away the gases which cause the pin-holes and porosity, etc.

Trusting my suggestion will be of help.—Yours, etc.,

William Wilkinson.

14, Pratt Lane,
Shipley.

March 6, 1933.

Messrs. William Cumming & Company, Limited, of Kelvinvale Mills, Maryhill, Glasgow, have taken over the business of the Glasgow Patent Moulder's Blacking Company (1925), Limited. This firm, which has been established for nearly a century, were the original makers of the Glasgow Patent Moulder's Blacking. The specialities of both firms will continue to be placed on the market, all of which will be manufactured by William Cumming & Company, Limited.

Influence of the Carbon Content on the Structure of Grey Cast Iron.

Writing in "Die Giesserei," Nos. 1/2 and 3/4, 1933, Dr.-Ing. A. Koch and Prof. E. Piwowarsky, of Aachen, describe researches carried out by them regarding the influence of the carbon content on the structure and the mechanical properties of grey cast iron, taking into consideration various silicon contents, casting temperatures and wall thicknesses.

A series of cast irons made according to a uniform melting and casting procedure, but having different carbon contents, gave the following results.

With increasing carbon content the graphite content of the cast iron rises; the weakening of the structure by the increasing closeness of the graphite filling causes a lowering of all mechanical properties. As the liquidus line rises with falling carbon content, the "effective" superheat decreases, at constant casting temperature, with diminishing carbon content. The solid solution is deposited with numerous nuclei. The refining of the ground structure and of the graphite lamellæ hereby brought about improves in especial degree the repeated-impact strength.

Silicon enhances on the one hand, by depression of the temperature at which the deposition of solid solution begins, the life of the cast iron. On the other hand, by favouring the precipitation of graphite and the carbide decomposition, silicon impairs the mechanical properties. Increased cooling speed (limited wall thickness, low pouring temperature) partly cancels again the influence of silicon; there is, accordingly, for every carbon content, for every pouring temperature and thickness of casting, an optimum silicon content.

With increasing wall thickness the graphite content rises—in approximately the same measure a fall occurs in the transverse and tensile strengths. The sensitivity to wall thickness decreases with falling carbon content. Whilst transverse and tensile strengths directly depend upon the graphite content and upon the influence exerted thereon by the wall thickness, the refining of the structure and of the graphite lamellæ with low wall thicknesses brings about, especially in the case of low-carbon cast iron, an extraordinarily marked rise of the repeated-impact values. With increasing wall thickness the hardness is influenced both by the increments in the graphite content and the structural alteration of the ground structure.

With ascending casting temperature the heating up of the mould increases, the actual freezing process is thereby retarded, the separation of graphite promoted. The mechanical properties, in accordance with the augmentation of the graphite, deteriorate. For the attainment of high mechanical values a casting temperature as low as possible is therefore requisite, whose lower limit is set by the fact that the liquidus point which corresponds to the composition of the iron must not be understepped before the mould is completely filled even in the narrowest sections, as by premature deposition of the solid solution during pouring the mechanical properties are prejudiced in marked degree. Pouring through the mould brings about, in similar fashion to a heating up of the mould by raising of the casting temperature, a considerable falling-off in the mechanical properties of the iron. The values obtained with test-bars can be influenced within the widest limits by alteration of the pouring temperature and casting procedure.

The Metropolitan-Cammell Carriage, Wagon & Finance Company, Limited, of Saltley, Birmingham, and the Birmingham Railway Carriage & Wagon Company, Limited, of Smethwick, have each been awarded an order by the L.N.E.R. for ten pairs of articulated coaches of a new type primarily designed for use in long-distance excursion traffic.

Random Shots.

I have just been reading one of those cheery little Russian novels. Almost every character in the book came to a nasty death sooner or later in the 1,679 pages. Yet you could hardly call it a tragedy, because the characters were all so repulsive that nobody could really care much about them either way. In fact, when the father drank himself to death, the mother committed suicide, the sons were burnt to death, the daughter murdered, and her lover executed on a false charge, I could not help feeling that all was bending to the general good. In fact, when the last *moujik* left alive drank poison in mistake for *vodka*, one was left with a feeling of distinct satisfaction.

* * *

However, I was mainly interested by a foreword which lavished praise on the author—Turgenev or Maxim Gorki, I forget which—because, so it was said, the unrelieved gloom of his writing faithfully reflected the life of the Russian peasantry, or, in fact, any people who had to force a meagre living out of the hard soil. Now I think that is just where these Russian novelists go wrong. Take the case of the foundryman, who, after all, has to force a meagre living out of the hard world just as much as any *moujik*.

Do we find the foundryman living in unrelieved gloom, murdering his wife and throwing the children out of the window? Well, not often—not very often, at any rate. Few members of the Institute of British Foundrymen look as if they ever felt like doing so, except perhaps to professional thought-reader. I have known some of them who seemed quite cheerful at times. But, according to these Russian "literary gents," this is how we should visualise the scene on Monday morning when the weather is bleak and trade worse.

* * *

Scene: Office at the "Cherry Orchard" Foundry. Time: 9.30 a.m. Enter a man staggering slightly and at times hiccupping. "Ha! Miss Smith, little daughter," he growls (if one can growl and hiccup at the same time), "what a miserable devil I am! Who wants to buy castings from a miserable devil like me?" "Are we not all miserable, little father?" begins Miss Smith, his typist. She never ends, because our hero, knowing his cue, draws a revolver and shoots her. The door is flung open, and a clerk rushes into the room. Sighing deeply, our hero shoots him down. "Poor Albert, little brother!" he muses. "Why did I shoot you? But life is like that!" Silently he weeps for an hour or two, and then quietly he draws from his pocket a bottle of *vodka* and a box of matches. As he drinks deeply he casually sets light to the office, sighing still more deeply, "Trade is bad, but life is like that!" A noise is heard in the outer office. The police charge into the room just as a shot rings out.

* * *

Does the scene ring true? No! We foundrymen are made of sterner stuff. The comparison is ridiculous. Why mention it at all? I do not know. Life is like that.

Marksman.

The recent greater activity in shipbuilding on the North-East Coast of England has resulted in more men being started at the Templetown foundry at South Shields of Messrs. Charles W. Taylor & Son (North Eastern Foundries), Limited. The firm has two foundries—one at Laygate, South Shields, and the other at Templetown. In normal times 400 men are employed, but owing to the Laygate establishment being closed in 1930 less than 50 per cent. of the workmen are in employment.

Sand Testing in the Foundry.*

By W. Y. Buchanan.

Permeability Apparatus.

The apparatus shown (Fig. 1) was designed by Mr. R. J. Richardson, and the description appears in The Foundry Trade Journal, Vol. 47, No. 841, in a Paper, "Black Sand," by Hird. It consists of two tanks, one above the other, with water flowing from the top tank to the bottom so as to displace air through the test-piece under standard conditions. Some slight changes were made in the original design, namely:—(*a*) A rubber tube was introduced into the $\frac{3}{8}$-in. pipe for ease in coupling up, and to remove strain; (*b*) the core tube was connected directly to the tank for stability, the hole in the drum being the full size of the test-piece; (*c*) the "U" tube was connected to the water-

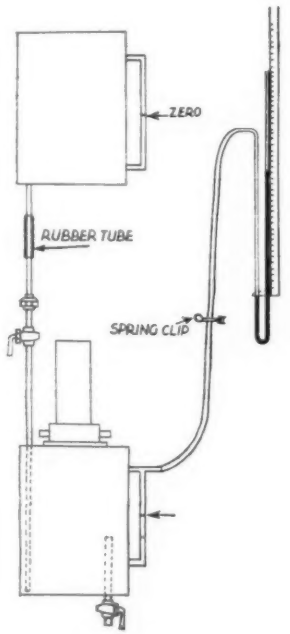


Fig. 1.—The Richardson Permeability Apparatus.

gauge fitting for simplicity; (*d*) a spring clip on the rubber tube connecting the "U" tube was used to simplify the manipulation of the apparatus. This clip is held open till the water has reached zero. It is then released so that the column in the "U" tube remains at rest and the reading can then be taken carefully; and (*e*) the extension of the exit tube into the lower tank allows the same quantity of water to be run out each time without special attention.

This type of apparatus is convenient to use in the foundry, as it gives a reading which is actually "back pressure" caused by the nature of the test-piece, very similar to the back pressure encountered by the metal in driving air from a mould during casting.

An attempt was made to settle the question of the first explosion or the quiet burning time when using the B.C.I.R.A. permeability apparatus by the aid of Richardson's apparatus. Cores were made at 1.3, 1.4 and 1.5 density and tested in both the B.C.I.R.A. and Richardson's apparatus. The time for one litre to pass through the apparatus as well as the back pressure was noted then by an approximate calculation; the permeability on Richardson's was expressed in rate of flow of air through the test-piece under 10-cm. pressure.

* A Paper read before the Edinburgh Section of the Institute of British Foundrymen, Mr. William Wallace presiding.

It was assumed that, under the same conditions, gas and air would pass through the core at the same rate. Then the Richardson figure, rate of flow at 10-cm. pressure denoted by (R) multiplied by the B.C.I.R.A. time in seconds at 10 cms. (B) should give a constant

	Explosion.	Quiet burning.
At 1.3 density (R × B)	7	7
„ 1.4 „ (R × B)	8	11
„ 1.5 „ (R × B)	10	14

The above are the average of four sets of tests, which serve to show that the "explosion" time is the true permeability.

Other reasons in favour of reading the time at the first explosion (when it occurs) are:—(1) That it is audible while the commencement of quiet burning is often difficult to detect in strong daylight; (2) if this period of explosions is due to gas being "washed" out of the apparatus it must occur even when, as in the case of highly-permeable cores, no explosion occurs. The first gas to appear must contain air, and it is difficult to say when this excess of air disappears

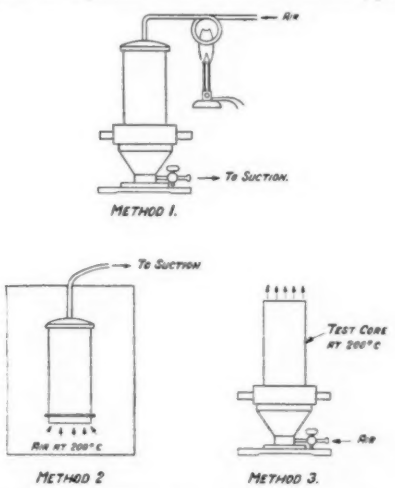


Fig. 2.—Three Methods for Testing Permeability.

from the flame; (3) the error is greater in the B.C.I.R.A. permeability test when using the "quiet burning" time instead of the time of first explosion, 5 per cent. increase in the error having been noted, and (4) since the core is free from gas to start with, the instant of the first appearance of flame at the top of the core is the time taken by the gas to complete its passage through the core, and any further time allowed must be in excess of the true figure.

Permeability of Sand in the Dry State.

The permeability of sand in the dry state was carried out quite successfully by the method (Fig. 2) previously described,* that is, the test-piece was removed from the cylinder, dried and replaced for testing in the dry state, the cylinder being very slightly tapered. However, with oil-sand of very low green strength, the test-pieces after being removed from the cylinder bulged at the bottom end under their own weight and were thus rendered useless. To overcome this trouble several methods were tried.

1st Method.—An attempt was made to harden up what becomes the lower end, by drawing heated air through the test-piece. The success of this method depends to a great extent on the efficiency of the suction, the bore of the air-inlet tube and other factors.

2nd Method.—The test-piece was dried completely at 200 deg. C. in the cylinder by drawing the hot stove gases through. This allowed the expansion, if any, to take place all in one direction, as the suction end was kept moist to the last. The time required depends on the efficiency of the suction. This experiment took about 10 hrs.

3rd Method.—The test-piece and cylinder were raised to 200 deg. C., throughout (time given

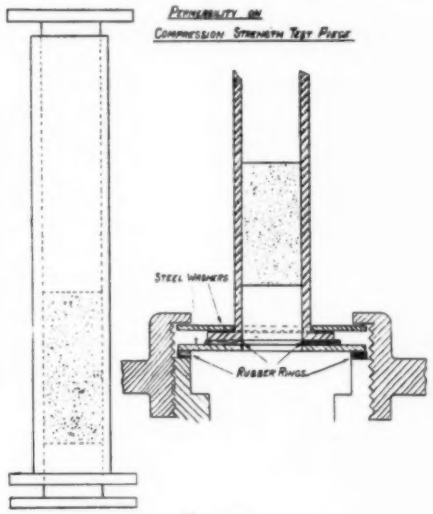
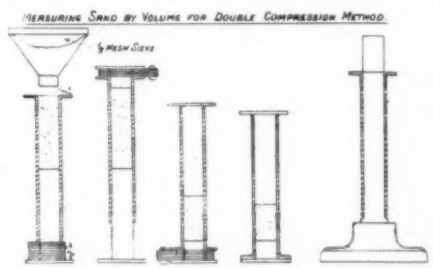


Fig. 3.

2½ hrs.) and then placed in position in the B.C.I.R.A. permeability apparatus and cold air blown through the core. The test-piece cooled to room temperature in 25 min. and a considerable quantity of oil vapour was given off. For drying the test-piece in the cylinder, a tapered bore is not necessary and little molasses on the lower end of the bore, for about 1 in. will prevent the sand from falling out, whilst in the green state. The permeability at 1.5 density and 10 cms. gas pressure was 9 to 12 sec. Tests of this nature indicated that there



Figs. 4-8.

was no change in volume or permeability on drying.

Double Compression Core Tube.

After making this experimental permeability apparatus an attempt was made to get the permeability and strength figures on the same test-piece. The British Cast Iron Research Association's strength and permeability test-pieces (Fig. 3) are of somewhat similar proportions and so the strength test-piece was used for both. The mould was used in the form a tube instead of a split core box used hitherto. The test-piece can be rammed by double compression, single compression, or by hand ramming and the tube attached to the permeability apparatus by means of a screwed coupling or more conveniently by a rubber bung on the tube connected to the apparatus. Using a suitable stripping post, the test-piece can readily be freed from the

* Foundry Trade Journal, February 18, 1932, page 113.

core tube for green-strenth testing or for baking for dry-strength testing. The penetration test* can be carried out exactly as before.

The difference in hardness between the top and bottom of the double-compression-made test-piece may be accentuated if more than the necessary secondary compression is added. This is due to the fact that, having been partly compressed to less than the final hardness, the sand at the top end does not flow under the effect of the secondary compression. Hence the sand sample should be in the properly aerated condition and should be dropped quite loosely into the container or tube, which should be of ample length to avoid the necessity of pushing it down to get in the whole sample.

Measurement of Sand by Volume.

Since the variation of moisture causes a variation of weight of unit volume of sand, or, in other words, when measuring by weight moisture replaces sand, it was hoped to eliminate this effect by measuring by volume instead of weight for foundry tests.

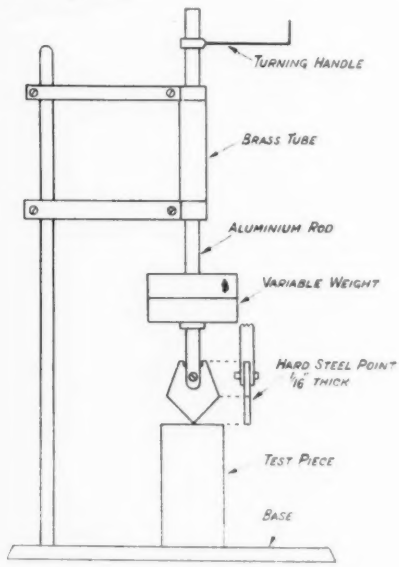


Fig. 9.—Showing the Penetration Tester for Green Sand.

The method suggested is set out in Figs. 4-8.—Set distance piece at, say, 1 in. (this can be varied to alter the density required) under the 5-in. plunger. Invert and place under the filling funnel, the height of which is fixed. Pass sand through the sieve and strike off level when filled (Fig. 4). Raise the tube and place the 1-in. plunger in position with the usual distance piece, say $\frac{1}{8}$ in. (Fig. 5). Proceed as in double compression and carry out the permeability test (Figs. 6 and 7) and use the stripping post to free the test-piece for green-strength test or for drying for dry strength (Fig. 8).

This should hold good so long as the moisture variation is not so great as to change the flowing properties of the sand when filling the tube.

Penetration Tester.

This apparatus was described in a previous Paper.† In short it consists of a steel wire driven into the sand by a falling weight. Another method which is similar is that by Prof. Aulich, but in this case a tube is driven into the sand. This seems to be more complicated than the steel-wire method and requires a flat surface. Moreover, it will cut out a piece from the mould. There is also an American method devised by Dietert which is a small pocket instrument measuring the penetration in thousandths of an inch, of a steel ball into the surface of the mould. This measures only the skin hardness, whilst the others will test a layer equivalent to the usual depth affected by the hot iron.

Hardness Tester for Dried Sand.

The penetration tester (Fig. 9) is suitable for testing sand in the green state only, yet it is often necessary to test cores, particularly oil-sand, after drying. For this purpose a drill type

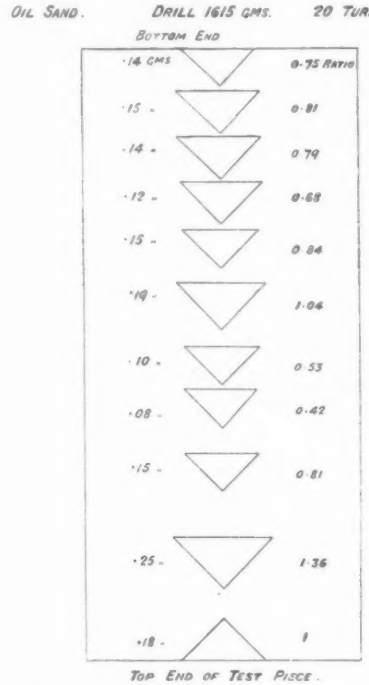


Fig. 10.—Results of Drill Test on B.C.I.R.A. Standard Test-Piece.

of hardness tester was used. This consists of a vertical rod having a spear point and loaded with a standard weight. This is held in a vertical position and is fitted with a loose handle or key for turning so that the vertical movement of the rod is not interfered with.

There are several ways of noting the hardness:—(1) Using a standard weight and the number of turns, measure the diameter or depth of the hole; (2) count the number of turns required to sink the drill to the top of the "V," and (3) using a standard weight and the number of turns, weigh the dust.

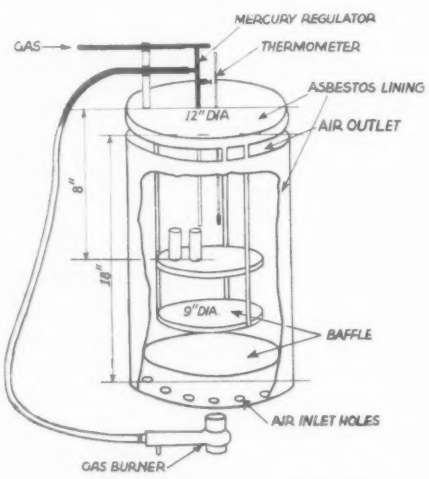


Fig. 11.—Experimental Drying Stove.

The third method was used, *i.e.*, weighing the dust. For duplicating the results, three holes can be drilled and after weighing the combined dust the result divided by three. This makes one weighing instead of three and reduces the time required. The method is very sensitive and will show up variations in hardness which are otherwise unnoticeable.

Example.—A 1-in. square oil-sand test-piece was to all appearances quite uniform. On testing each side in turn the following weights were obtained:—0.25; 0.25; 0.76 and 0.32 grams. On examining more closely the side giving 0.76 grams, it was observed to be slightly burnt. The only practical method of testing oil-sand cores

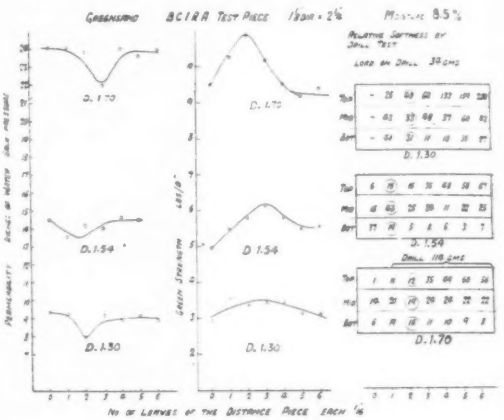


Fig. 12.

for burning is by scratching the surface with a sprig or by noting the colour.

2nd Example.—Fig. 10 shows a sketch of a B.C.I.R.A. test-piece $2\frac{1}{4}$ in. by $1\frac{1}{8}$ in. tested throughout its length. This has been drawn carefully to scale to show the relation between the methods of measuring the diameter of the hole and weighing the dust.

Drying Stove.

The drying stove shown in Fig. 11 consists of a drum having holes in the bottom near the walls. Suspended from the lid is a tray for carrying the specimens, and under this is a similar tray which acts as a baffle only. A large baffle is fixed a few inches above the bottom of the drum, which is exposed to the flame of the gas burner. The object of the baffles is to prevent radiation from the bottom of the drum and the possible over-heating of the bottom of test-pieces. The gas passes through a mercury regulator which maintains the temperature constant, and the top and sides of the stove are lined with asbestos to prevent radiation losses.

After placing the test-pieces on the tray, the top is lowered into position. A good supply of hot air passes through the stove, entering at the holes in the bottom and leaving at the top. If one burner be not sufficient to raise the temperature to that desired, a second burner may be connected to the gas and turned on full, while that connected to the mercury regulator can be adjusted as required. This stove is used for drying the test-pieces for strength testing and also for investigating the effect of drying temperature on strength of sands.

When using the compression-testing machine, care must be taken to have the plates which transmit the pressure to the test-piece parallel to the ends of the test-piece and prevented from moving during the actual testing. This is very important and appears to be receiving attention at the moment.

Uniformity of Double Compression.

The statement made in the discussion on the previous Paper* was that cores rammed by

* When compressing a test piece of high-density—such that the plunger cannot be pressed down easily by hand, the compression should not be completed by blows of a mallet as this may cause localised ramming to be referred to later.

† See Foundry Trade Journal, February 11, 1932, page 97 *et seq.*

* Foundry Trade Journal, May 19, 1932, page 302.

double compression would be hard at both ends and soft in the middle, or when put in another way by others interested in sand testing—"that true uniformity can only be got at one particular weight of sand." This has been carefully studied with a great deal of duplicating, *e.g.*, the graphs shown in Fig. 12 are developed from 130 tests, in addition to about 140 preliminary tests on various sands, oil sand, dry sand, Belfast red sand and green sand, and the conclusions from this figure are beyond the stage of theory.

Incidentally, the moisture at the beginning of these tests was 8.59 per cent., after 80 tests it was 8.56 per cent., and at the last few ounces of sand 8.44 per cent., which indicates the benefit of using the mixing drum to prevent loss of moisture during testing. It will be noticed that at the three densities which cover the moulding range the test-pieces have a marked increase in both permeability and strength when made with a distance piece $\frac{1}{8}$ in. to $\frac{3}{16}$ in. thick.

Referring to the "relative softness" figures which are in centigrams weight of sand bored out by the standard drill (34 gms. weight and 20 turns), it will be noticed that as the number of leaves of the distance piece is increased the top of the test-piece becomes softer, while the bottom becomes harder and the centre remains prac-

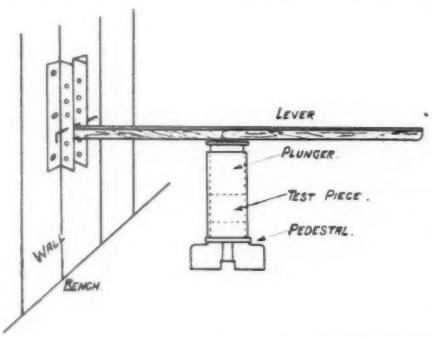


Fig. 13.—Shows the Addition of a Single Plunger to the A.F.A. Ramming Apparatus.

tically the same. There is therefore a point at which the hardness is uniform about $\frac{1}{8}$ in., and these tests are equally uniform in degree of ramming over the whole range of mould density. The explanation of the increase in permeability is that the hard cake caused by squeezing all in one direction has been eliminated by the $\frac{1}{8}$-in. secondary compression.

Similarly in green strength, when one end is hard, the other is correspondingly soft, and the strength measured is that of the weakest part. The fracture of test-pieces moved from the lower part at no distance piece to the upper part at $\frac{5}{16}$-in. distance piece. Where the soft part at the lower end is relatively short, as is possible in a shorter test-piece, this may "flow" until the compression is taken up by the hard part, and in this way actually give a correspondingly high result in testing.

Test-pieces of extremely low density can be made by this squeezing method, which is proof of good ramming. The double-compression-made tests have been shown to be equal to perfectly-made hand-rammed tests, and under ideal conditions hand-rammed tests are uniform throughout. It will be noticed that when the hardness of the ends is equal the test-piece is quite uniform.

The Application of Drop-Weight Ramming to the B.C.I.R.A. Small Test-Piece.

On considering the so-called "sensitivity" of the double compression test-piece to alterations in weight (or the weight effect of moisture variation), it should be remembered that at a normal degree of ramming—say 45 per cent. of the volume is air space. Now $\frac{1}{16}$ in. variation in length—though a small proportion of the volume of the test-piece—is a relatively large proportion of the air space volume and this 45 per cent. is the only portion capable of further reduction in volume with further ramming. In the so-called standard ramming by drop weight, variations in weight are reflected in variations in volume which tends to keep the air space volume constant.

Thus the drop-weight ramming method may be said to be insensitive to changes in weight of sand. This, however, is complicated by alteration of the properties of the sand due to change of moisture such as flowability, resistence to ramming, or internal friction. The application of the drop-weight ramming method to the B.C.I.R.A. small test-piece has been suggested as a means of removing the sensitivity to weight errors.

A number of tests have been carried out on three widely different types of sand—green sand, oil sand and steel-foundry sand, obtained for the purpose. With drop-weight ramming (4.45 lbs. weight, 2-in. drop, four blows top end), the ratio of softness figures for these sands were:—

Top	1	1	1
Bottom ..	21	8.5	24

while with double compression the ratio was $\frac{1}{1}$ in each case.

The difference in permeability drop weight = 10.9 and double compression = 8.26 in the green-sand test is typical, and the density was very much lower than the average practice. The tests were repeated with a 14-lb. weight, 2-in. drop, two blows each end and this gave a very hard test-piece, about the maximum possible, with a ratio of $\frac{2{\cdot}5}{1}$ and 28.2 in. permeability against $\frac{1}{1{\cdot}2}$ and 25.5 in. by double compression. These do not exhaust the possible variations of the drop-weight method but suffice to show that the A.F.A. standard ramming method does not apply to this test-piece.

The A.F.A. Test-Piece, 2 in. by 2 in. dia.

The unequal ramming noted in the $2\frac{1}{4}$ in. by $1\frac{1}{2}$ in. when standard rammed by drop weight is also observed in the A.F.A. 2-in. by 2-in. test-piece, to a lesser extent. This difference in hardness is shown in Dietert's Paper to vary with the flowability of the sand. This standard ramming is interpreted by some people to mean ramming to a uniform density or degree of hardness. This is not so. The only thing which is standard is the force of the blows. For instance, Dr. Ries found variations of from 1.7 to 1.94 apparent density on various sands with A.F.A. standard ramming, and that increased water always gave increased density. He also claims that with uniform water content and ramming the apparent density will vary with the texture of the sand. This is referred to elsewhere.

Comparing the standard A.F.A. drop weight and the double-compression methods of making the 2-in. by 2-in. test-piece:—

A.F.A.		Compression.	
		Single.	Double $\frac{1}{16}$ in.
Permeability (back pressure in ins.)	6.1	6.0	5.9
Green strength composition in lbs.	20.0	20.0	20.1
Penetration test in mms. { Top	15.5	15	18
Penetration test in mms. { Bottom	20.5	17	16.5
Drill test ratio .. .. { Top	1	1	1.1
Drill test ratio .. .. { Bottom	1.3	1.1	1

These are not actual test results, but are computed from some 250 tests. They have been difficult to obtain, as the error in the permeability test is very much in excess of the difference in permeability of these test-pieces due to the method of ramming. Duplicates on the same test-piece (without removing it from the apparatus) were often as bad as the following particular case:—5.6, 6.4, 5.2, 6.6, 6.1, 5.3, 5.3, 6.4, 5.4. Thus after nine tests the true result is still obscure. The reason for this is not known, but is entirely due to the apparatus.

The conclusion from the above is that the double-compression method is not only equal to but slightly superior to the A.F.A. standard-ramming method even on this short test-piece. Thus, by the addition of a single plunger of the proper dimensions to the A.F.A. ramming apparatus, the advantages of the variable density methods can be added, as shown in Fig. 13. The combination of these methods is, perhaps, ideal, as it allows the use of the apparatus in checking the quality at the sand plant, where large errors in weight are said to be encountered, and the A.F.A. type of ramming, by virtue of its variations in length, is comparatively insensitive to such errors.

Oil sand is much less subject to variation of hardness, especially when the green strength is low. The test-pieces crumbled on the lower edges with handling after baking. A $\frac{1}{32}$-in. secondary compression seems sufficient to produce a uniform test-piece by double compression. The formation of voids or openness at the corners sometimes gives a low back-pressure by allowing the air to take a short cut. These conclusions are based on 65 tests done solely for this purpose.

Proportions of the A.F.A. Test-Piece.

The A.F.A. test-piece has evidently been shortened to suit the type of ramming, while the B.C.I.R.A. test-piece was designed to give the proper compression test. The A.F.A. 2-in. by 2-in. test used for compression-strength test bursts is like a barrel with the ends pushed in. This is not a true shear, and it is questionable whether the result in lbs. per sq. in. is correct.

Flowability.

Flowability of moulding sand is the ability of sand to flow under ramming energy to form a smooth uniform surface. This property is important, especially with machine moulding. This property may be expressed numerically by the ratio of hardness-top to bottom-of a test-piece squeezed all in one direction. The proportions of the test-piece should be similar to those of the B.C.I.R.A. test-pieces.

(To be continued.)

"Inventio."

The Czecho-Slovakian Foundrymen's Technical Association informs us that a new company has been formed at Prague called the "Inventio," the aims of which will be to organise the exchange and use of patents, inventions and methods of manufacture in the foundry both in Czecho-Slovakia and in other countries.

The Society will protect foundrymen against purchasing worthless patents and inventions, while it will also give publicity to those inventions and novelties of interest and of use for improving the art of the foundryman.

The Society was formed by the leading Czecho-Slovakian foundry experts. The technical side will be under the direction of Prof. Pisek, of the Brunn Technical High School, and the firm of "Kalcium" is also collaborating, whilst a number of well-known foundrymen abroad as Mr. Bacher, of Roudnice, and Mr. Pulpan, of Prague, are also connected with this new venture. The address of the Society is "Inventio," Prague 11, Panska 9.

Does Science Help the Foundry Industry?

The meeting of the East Midlands Branch of the Institute of British Foundrymen, held at Loughborough College on February 18, was a departure from the usual Paper and discussion, taking the form of a debate on "Science and the Foundryman."

The Branch-President, Mr. C. W. Bigg, said it was regretted that Mr. T. Goodwin had been unable to take the lead for the foundryman on account of his illness, but they were fortunate in having a very able substitute in Mr. H. Bunting. Mr. H. Sanders would lead for science and would speak for the first 15 minutes. Mr. Bunting would then have a similar time, and each speaker would be allowed a further 5 minutes to reply.

How Science Helps.

Mr. Sanders said the art of founding had been practised for generations in a traditional and conservative manner, most foundries having their own secret mixing of the particular metal cast. In view of their lack of knowledge it was undoubtedly wise to stick to anything approaching satisfaction rather than experiment, but such a state did not lead to progress, and progress was essential to the foundry trade, if merely to hold its own against competitive materials. Science was helping the foundryman to overcome his many difficulties, to obtain better use from the materials available and to improve the quality and widen the market for castings. He would try to show how scientific knowledge could be applied in the foundry:—(1) In the selection of raw materials, (2) in the use of these materials and (3) in research and its application. Raw materials, he said, comprise metals and alloys, fuels, fluxes, refractories, sands, binders and facings. Most occurred naturally or had undergone only one manufacturing process, and, consequently, were rather variable.

The Scientists' Tools and Methods.

The selection of suitable metals, checking the composition and detecting harmful impurities before damage was suffered, constituted a rigid control; perhaps the greatest service science could render the foundry. With such control, the foundry could purchase in the best market with full confidence and could be certain of metal of the correct composition, thereby eliminating one cause of wasters. Any heat-treatment could be scientifically controlled to the founders' benefit.

Pure metals were generally soft, but weak and unsuitable for castings; greatly improved properties being obtained by alloying. At a definite composition, the eutectic, an alloy had its lowest freezing point, when it freezed solidly and progressively from the outside just like a pure metal. Alloys not of eutectic composition threw out the predominating constituent as crystals until only the eutectic was left, which froze around the primary grains. A small variation in composition could alter the entire character of the alloy by varying the primary constituent or by birth of a new undesirable constituent. The internal structures of alloys were visible under the microscope; to which scientific instrument alone metallurgists owed their knowledge of the freezing of metal and the subsequent changes on further cooling. Micro-examination had proved particularly useful in the investigation of foundry troubles, segregation, microscopic porosity, annealing of malleable cast iron, hardening and tempering steel and grey iron.

Non-Ferrous Alloys.

Some of the ready-mixed alloys, such as brass, gun-metal and aluminium L.5 and L.11 were compounded of a proportion of scrap, with the danger of uncertain composition and the greater danger of contamination. Of many non-ferrous alloys the limits of composition were very narrow, a small variation or a small impurity could alter the entire physical character and render it useless. Examples were the bronzes, phosphor, aluminium and manganese, and the strong aluminium alloys—Y-alloy, Duralumin and Alpax. The re-melting must be carefully controlled to allow for loss of volatile or easily oxidised elements or gain of impurities, and the casting temperature controlled by thermo-electric pyrometer, or distinctly inferior properties result.

Aluminium is noteworthy in that its use is due entirely to the work of scientists. It was so difficult to reduce that until the discovery of the electrolytic process it was merely a chemical curiosity. Its alloys with zinc, copper, magnesium, iron, silicon and nickel have been examined, the phases, heat-treatment and age-hardening investigated, with the result that engineers could have castings as strong as steel of only one-third the weight. The heat-treatment of Y and RR alloys demanded accurate pyrometers and equally accurate furnaces. Magnesium, with its alloy electron was a result of a metal born in the laboratory and progressing to the foundry. The use of nickel they owed to the discovery by Mond of the nickel carbonyl process of separating nickel from its associated metals.

Steel for Castings.

Steel for castings was usually made to the same exacting limits of sulphur and phosphorus as for rolling: except for the basic-electric process it was usually made in acid furnaces, with a slight gain of sulphur and phosphorus. The pig-iron must be bought to analysis and analysed, this applying also to spiegel, ferro-manganese, ferro-silicon and the more expensive alloys, which were bought on a percentage basis. The open-hearth and electric were both processes in which the stock was melted under a slag and brought to the desired composition. It was usual to take a bath test for carbon as soon as melted, and base the working and additions on the result. Later, tests were taken and assayed for manganese and carbon, the necessary additions made and the final composition checked before the moulds were cast. The silicon content of the molten iron charged to the converter controlled the heat evolved during the blow, and must be sufficient to heat the steel to the required degree. After the blow, the steel was adjusted with manganese, silicon and anthracite to the desired composition. Super-refined steel was made in the basic electric furnace, where sulphur and phosphorus could be reduced to very low limits. The melt of turnings and heads was usually sufficiently oxidised when melted for dephosphorisation, a test showing less than 0.10 per cent. carbon and 0.009 per cent. phosphorus. The dark slag, with a high ferrous oxide content carrying most of the phosphorus, was raked off. Anthracite and ferro-silicon added to deoxidise the bath, and the steel finished under a white limey slag which eliminated the sulphur. Bath samples were taken before finishing.

Grey Iron Founding.

Grey iron founding was a much easier business. With a cupola and some No. 3 or 4 pig, quite presentable castings could be made. When only cold- or warm-blast irons were made, and both engineers and founders believed in plenty of weight (priced per cwt.) everyone was satisfied. To-day, the object was to reduce weight; castings were more highly stressed, and the founder had to meet exacting mechanical and physical tests, and must give satisfactory service, or the castings were replaced by competitive materials. Cast iron was used for a wide range of purposes and was called upon to withstand shock, wear, heat or corrosion, and, thanks to the metallurgists, these demands were being met. The grades of pig-irons were correspondingly variable, ranging from 2.5 to 4.5 per cent. T.C., 0.5 to 5 per cent. Si, 0.03 to 1.75 per cent. P; the last was, however, constant for any particular brand. Silicon was the most variable and the most important element, and the content desired should certainly be specified when buying. The fracture of the pig indicated the size of the graphite, quite an important feature, but it was not a very good guide to the silicon content. Fracture depended on the total composition and thermal history, and the effect of the latter was destroyed on re-melting. No. 3 iron could vary from 2 to 3½ per cent. Si, and actual analysis of a brand of No. 4 ranged from 1½ to 3 per cent. Si. Buying to analysis had no difficulties and many advantages.

T.C. and Si.

The quantities of graphite and combined carbon determined the character of the iron; the amounts of other elements were of importance, chiefly so far as they effected the state of the carbon. Heavy sections cooling slowly were coarse grained and weak unless steps were taken to prevent it. Non-ferrous founders employed chills; steel castings were normalised; the composition of grey iron was controlled to counteract slow cooling. The separation of the graphite was promoted by slow cooling, by increase of total carbon and increase of silicon, so that for a given section there was a range of silicon and total carbon available to obtain the desired combined carbon content associated with fine graphite.

The total carbon and silicon were interdependant and within limits could replace each other, but the T.C. had the effect of controlling the expansion resulting from the graphite separating, which tended to counteract the liquid shrinkage. Hence low T.C. irons tended to sink on the top and needed more feeding, but high T.C. irons had a longer freezing range and exhibited internal shrinkage and porosity. High silicon could cause the same defects unless the T.C. was correspondingly low. Fracture tests of sections similar to the castings, and a daily transverse test are very helpful in maintaining control.

Influence of Phosphorus and Sulphur.

Phosphorus was the foundryman's friend. It increased fluidity, refined the grain and reduced the tendency to chill, but had the disadvantage of weakening the resistance to shock. However, if under 1.0 per cent. and associated with a suitably low carbon and silicon, it existed in a network structure with little effect on the static strength, whilst the wearing properties were improved. Sulphur did not cause blow-holes, even if not balanced by manganese. A reflection on the analysis of white-heart malleable iron would confirm this, but in grey iron the sulphur should always be accompanied by excess of manganese, especially in thin sections, or chilling and inverse chilling would occur. The cupola was deservedly popular as the most efficient furnace, with the advantage of not greatly changing the composition of the charge, the temperature reached was limited, and a low total carbon, under 3 per cent., was not easily or regularly attained.

Malleable Cast Iron.

Malleable cast iron demanded close control so that no free graphite was present in the as-cast condition, but the hard carbide must be completely broken down by subsequent annealing. Such a delicate balance of composition and accurate annealing was necessary with the black-heart process that it was impossible to make first-class castings without scientific control. T.C., S, Mn and Cr and P must be kept to a definite low maxima and the silicon controlled within plus or minus 0.10 per cent. The composition range of white-heart was not so exacting, but greatly-improved material was obtained by melting to close control, especially the carbon content, and annealing under pyrometer control.

Coal and coke for melting must be low in sulphur, and, for the sake of thermal efficiency, low in ash. The lime, limestone and fluorspar must be reasonably pure and free from sulphur.

Refractories.

The analysis of a refractory was an index of its suitability the process involved, bases were objectionable in acid refractories, silica in basic and the alkalies extremely detrimental in all, but a little flux was necessary to bind the grains. Physical characteristics, such as degree of porosity, mechanical strength and resistance to spalling were equally important. Research on moulding sands had proved valuable to the foundry. It had shown certain sands, hitherto regarded as excellent, were by no means ideal. Red sands of the Midland counties contained quantities of silt, which had no bond and lowered permeability. Permeability was influenced more by silt than by grain size. Information such as moisture content, compression strength, permeability number and grain size was definite and capable of universal interpretation in 10 days' or 10 years' time, whereas terms as fairly dry, strong and open were vague and capable of very different meanings in different foundries.

THE REPLY.

MR. H. BUNTING, replying to Mr. Sanders, said he was sure that all regretted it was necessary for him to be in that position, as he was certain that Mr. Goodwin, had it not been for his illness, would have handled the debate far better. Mr. Sanders in his opening remarks had stated that a foundryman's job was a practical one. Was it necessary for him (Mr. Bunting) to say any more? For discussion he would place the different sections into two groups:—(*a*) foundrymen and (*b*) chemists, metallurgists, engineers and draughtsman. The foundryman's job had often been defined as "rule of thumb" which was often described as ignorance, chance, or guesswork. Prof. Turner, some years ago, defined "rule of thumb" in this way:—"When one takes hold of something the thumb met the four fingers and had a power of grasp equal to the four fingers, so that the rule of thumb was the rule of skill."

Science not yet "Exact Knowledge."

Was there anyone who would have the temerity to say that John Surtees was only a rule-of-thumb man in the accepted term. Could one say that scientific control would have made him a better foundryman or those old foundrymen, of whom we so often hear the wish expressed for their like to-day? Was this "lost" craftsmanship, as some would have us believe (he refused to admit that), due to some other cause. Mr. Sanders stated that science covered a vast field of learning. If many of the scientists would spend some time in the foundry, that would provide them with a vast field of disillusionment. He illustrated the allotropic nature of carbon; had not all foundrymen, at some time, seen the allotropic forms in castings, when two castings from the same box, of the same chemical composition, differed physically.

Was the scientist claiming that the allotropic form of carbon was due to him, if so, he thought the foundrymen would be only too pleased if he would take over the honour for the castings also. Mr. Sanders had given three directions in which scientific knowledge could be applied:—(1) In the selection of raw materials, (2) in the use of these raw materials and (3) in research and its application. Could two scientific men be found who would agree? How often had one heard lectures by scientific men, who, when answering questions, would say: "We believe it is" or "we assume that is so," and no finality expressed? If the scientific man was sound, and the scientific control, his method, how then was the foundryman to account for the great diversity of opinion? Take two firms engaged on a similar type of work under similar conditions with scientific control, and one declares a certain material is the better, whilst the other advocates an entirely different composition. In a case of this type, item No. 2 must fail. With item No. 3 he was in agreement, as the scientist and the foundryman were on one plane.

During the past 35 years the foundryman had been asked for a greatly-improved material, giving greater strength with less weight, and the foundryman had met those requirements without that technical training which until a few years ago had been denied him. The scientists mostly envisaged the foundryman as a being devoid of any intellect, and the scientists have proceeded to work to their ideas, with disastrous results in many cases. Unfortunately, for him, his opponent that evening did not belong to that section. He believed science could be very helpful, but it could also be an hindrance to production. Some years ago, when discussing educational matters, he had heard it said that it was useless to bother about education for the foundryman, as he could not even read a drawing, and yet many of us have seen important and intricate castings made in loam; jobs that had required tackle to be made, which had meant seeing through the job, and the foundryman has only had a rough sketch. Examine some of the castings the engineer bolts together and boasts of the job he has made. Such castings were being made before the scientist knew there was such a place as the foundry. Mr. Sanders had stated that grey-iron founding was an easier business, and had insisted that presentable castings could be made with a cupola and some No. 3 or 4 pig-iron. He stated, also, that silicon was the most-important element, yet a large number of scientists were saying that the carbon was the more-important element in cast iron. We were told that phosphorus was the foundryman's friend. He, Mr. Bunting, would say that phosphorus was no friend when one had thick and thin sections and bosses liable to give spongy places; and, again, there was contraction strains to contend with. Sulphur, said Mr. Sanders, does not cause blow-holes. If not, what did? In conclusion, Mr. Bunting said he believed the scientists could be helpful to the foundrymen, but they had their limits, when they could know their own limitations and work on lines accordingly, then beneficial work would accrue. There was one section of the people he had termed scientists who could help enormously, and that was the draughtsmen. If the draughtsmen understood more of the action of the metals of which they ordered the castings to be made, then he could agree with Mr. Sanders that the foundryman's job was an easy one.

The Opener's Reply.

MR. SANDERS, replying to Mr. Bunting, said he would still make the assertion that foundrymen were conservative. One moulder would make his castings in one way, whilst another would use entirely different methods. He agreed that good jobs had been made on "rule-of-thumb" methods; he was not running them down for that. Obviously, if a certain method or material had been proved satisfactory by experience, the foundryman would be foolish to change, but if that experience was combined with science, then progress would be made. As it was, if the one satisfactory source of supply failed, the foundryman was generally "in the cart." John Surtees, he agreed, was a great foundryman, and from the practical point of view did wonderful work, but he thought that had Mr. Surtees a small amount of knowledge of the constituents, it would have been helpful. In those days, however, most of the irons were of cold or semi-cold blast, and were a good grade of iron. One did not see many moulders in charge of foundries, said Mr. Sanders, and this was because the moulder, generally, did not see beyond his sand heap. Before he made a casting, the drawing had to be prepared and the pattern made, and it was very often, the patternmaker who decided how the job was to be moulded. If the moulder could not get on, he blamed the pattern, but as a general rule, patterns were very good, and did not let the foundryman down. The scientist could learn more in the foundry than the foundryman in the laboratory. The study of metals was a complicated work, and he was not aware that scientists disagreed so much as Mr. Bunting alleged. He would ask Mr. Bunting, did foundrymen agree on anything?

On the question of silicon in castings, Mr. Bunting had misquoted him. He had mentioned silicon as the most important element in pig-iron, not castings, and he believed that to be correct. The quantity of C.C. and G.C. he quoted as the important point in castings. Silicon in castings could not be altered except by the melting loss, or by mixing with steel, etc. The training of the scientist was not a human process. He was trained on definite facts from research and the human element was lacking.

He was provoking discussion when mentioning phosphorus. He knew of foundries using high phosphorus with complete success. Phosphorus had the effect of fining the grain, and he believed if T.C. was reduced as phosphorus increased, that would be satisfactory up to 1.0 per cent. The gas found in castings, generally came from the mould. Facing sands gave off a great amount of gas. As regards the research conducted in the foundry, he doubted whether the scientists would call that research, but he thought it important. Scientific knowledge had to be taken from the successes and failures in the foundry. Buying to analysis was advantageous, and if the foundry had the help of science it could specify analysis and get it.

Lack of Opportunities.

MR. BUNTING said he thought they would have had some information on the cause of blow-holes, but they had not. Mr. Sanders said the foundrymen were conservative; of course they were, because no one else could do their job. Science could go hand-in-hand with practice if the former were sympathetic. Moulders in charge of foundries and possessing insufficient foresight were consequent upon lack of opportunity. The middle-aged moulder of to-day has had no chance of securing adequate knowledge. If he attended the technical schools he was often taught by men who did not know the job. If he secured books, they were written "from the office window" and not by the men who had knowledge of the craft. It was only of recent years that really good books had been published. If he attended a metallurgical class he was taught the assaying of gold and silver, and nothing of his own product—iron. Things were different to-day, and thanks were due to the Institute. The foundrymen of the future would be able to talk scientifically to the scientific men.

He thought he and Mr. Sanders were in agreement that the scientist should assist in the controlling of the elements in the iron, and leaving the foundryman to produce the casting with that assistance, irrespective of the people who design the castings that could not be made.

MR. BIGG (Branch-President), opening the discussion, said he would prefer members to continue the points raised in the debate, rather than put questions to either of the principals.

MR. A. E. PEACE (Derby) said that whilst he was on the side of science, he still had to rely upon the foundrymen to make his bread and butter, so he had to be careful. He was disappointed in the way Mr. Sanders had opened, he was so courteous and gentle that one was apt to get a wrong impression. Mr. Sanders made out a good case for the value of science in foundry work. He (Mr. Peace) thought the case very sound, and Mr. Bunting, in contesting, had drawn quite a number of sound deductions from Mr. Sanders' remarks, but had slightly twisted them. He (Mr. Peace) did not think Mr.

(*Concluded on page* 181.)

XUM

Making a Chemical Pan.

By H. Meadowcroft.

Making a chemical pan does not seem difficult on paper, but in practice it teaches a useful lesson, as it was made with the minimum of time and expense as the tackle of the shop allowed. Fig. 1 shows a plan and elevation of the chemical pan which was 6 ft. 6 in. high, 37½ in. dia., 1¼ in. thick with a 3½-in. flange 2 in. thick, with four brackets to strengthen the flange and four feet brackets on which the pan rested when in use. The diameter of the dome was 47½ in. with a circular washer 1 ft. 4 in. dia. and 2 ft. deep on the top. The jacket cone inside the dome was 2½ in. thick with 1¼-in. metal all round it. The bottom flange part of the pan was made in loam, but all above the flange was made green sand with various parts skin dried, as will be shown later. Fig. 2 is a sectional view of the mould and core. The bottom part (1) was put on the foundry floor, levelled, and a spindle centre (SS) and a spindle were put in, then levelled and made secure. The boxpart was then rammed up with ordinary black floor sand and a strickle used to strickle roughly the shape of the flange of the pan. It was then strickled with slip or soft loam and dried. When dry, it was put back on the foundry floor over a cinder trench in the floor for venting purposes. The flange pattern, which was in six sections, was put in the strickled flange and then the two pulley rims to form the outside of the pan and centre core was put in position, together with the four brackets to strengthen the flange. Boxpart No. 2, as shown in Fig. 2, was put on and the bars which ran across the box near the sides rested in slots in the sides of the boxpart; these bars were for resting gaggers against to ensure a good lift, free from any danger of the mould dropping out.

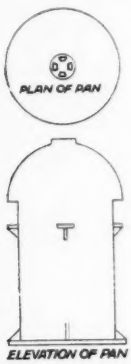


FIG.1

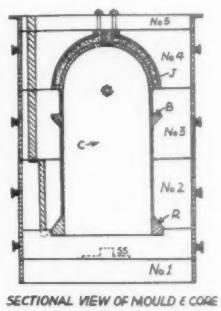


FIG.2

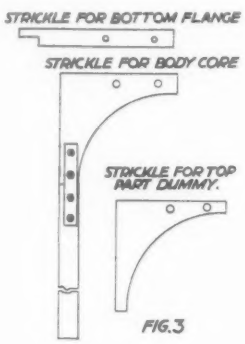
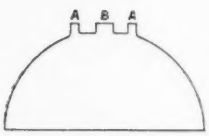


FIG.3



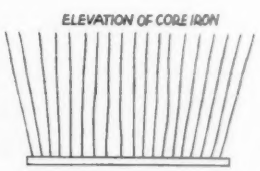


FIG.4

FIG.5.

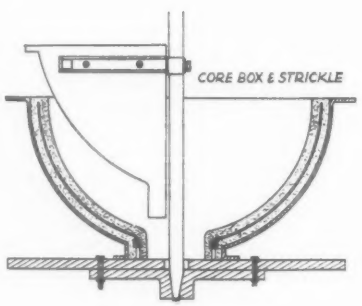


FIG.6

The mould and centre cone were then rammed up simultaneously and the 4-ft. brackets rammed in position. For venting during ramming, care was taken to connect each series of vents to a common channel. After each ram the mould and core were vented vertically down about 3 in. away from the face of both mould and core. In the case of the centre core the vents were connected to the bushes round the spindle by means of fine cinders and thus leading straight out to the coke trench under the bottom part. When boxpart No. 3 was rammed to the top, the sand dummy of the dome of the mould was strickled and a level joint made. The three wood staffs, which had been rammed up, just come level with this joint, thus bringing up the rims as a guide for the strickle to work to when forming the sand-dummy for the dome of the pan.

The round washer was then set on the top of the dome and boxpart No. 4 was put on and rammed up, and another joint made level with the top of the box and the pan. Then the top part (No. 5) was put on and rammed holes for runners, risers and vents were made. It was lifted off and finished. Next the washer was drawn out and boxpart No. 4, containing the dome part of the mould, was lifted off and finished. A strickle was then used to form a bed for the jacket core to rest on. This sand bed formed by the strickle was made to put the jacket core in the same position as when the job was cast. In other words, the jacket rested on a thickness of sand instead of metal. The jacket core was put in position on the bed and pieces of soft clay, which were whitened on top to show the positions for the studs, and thickness of metal were put on the core. There were eight round the skirt near the edge of the core and four about halfway up the dome-shaped side. Boxpart No. 4 was then put back and lifted off again.

The thickness of metal was shown by the compressed clays, and studs were fastened to the dome part of the mould where the whitening had left its mark. The clays were removed from the jacket core and the dome part returned. The top part, No. 5, was also put back and bolted to the dome part of the mould. The jacket core was then bolted up in position by means of threaded tubes, which screwed into the nuts cast in the core iron, which, besides holding the core, enabled the gases generated in the core to disperse. Now both parts and the jacket core were lifted until the time arrived for assembling the mould. The dome of the centre core was then strickled to shape. Long irons were driven in at right angles to the face of the dome to hold it in position during casting. It was then vented down to a cinder bed at a point about level with the base of the dome.

It was thought best not to have any cinders in the dome at all, as the ignition of gases generated during casting might cause the displacement of the sand on the face of the dome core. The vents of the outside of the mould were led off between boxparts 3 and 4, whilst, as the core vents were led through the bushes to the coke trench. Boxparts 2 and 3, which were bolted together were lifted off after the rims were drawn out, and the four bracket feet drawn in and this part of the job finished. Another strickle was used to check the walls of the centre core. It was then assembled for casting.

Arrangement of Runners.

There were two down runners which were stepped to break the force of the falling metal. It was run in the flange tangentially so that the metal was not against the face of the mould or centre core. The down runners were diagonally opposite. There was a runner at the base of the dome into which metal was poured to enliven the ascending metal; as the pan is steam-heated the jacket must not be porous at this place. Thirty-five cwts. of metal was used to cast it, and it ran quietly until it was just "up" in the two risers. The metal in the risers was still for an instant and then the metal began to heave gently. Pouring was slowly continued until the heaving stopped owing to the metal setting in the risers. At this moment the output of gases through the four vents of the jacket core increased, causing clouds of black smoke to shoot to the roof of the foundry. Apparently up to the moment when the jacket core was submerged the gases came through the four tubes, but immediately it was submerged the gases took the path of least resistance and escaped through the walls of the cone, thus causing the metal to heave until set. Fig. 3 shows the strickles used: the top one was used to form the bed for the flange to rest on. The bottom one was used to form the mould dome-dummy, then altered to form the bed for the jacket core to rest on and finally altered to form the dome of the centre core. The middle strickle was used to check the centre core. Fig. 4 shows a plan and elevation of the jacket core, which was made in oil sand, the vents leaving at AA and BB. Fig. 5 shows a plan and elevation of the jacket

(*Concluded on page* 181.)

Phosphorus in Low Total Carbon Cast Irons.

Work on Diesel Engines.

This Paper, which was published in our issues of February 2 and 9, 1933, gave rise to an interesting discussion: it was opened by Mr. J. S. G. Primrose, who mentioned that Mr. West was not the first research worker to investigate the problem with regard to phosphorus. Diesel-engine makers had also found, for a very long time, that that substance was decidedly a very bad bugbear. They advanced from 0.5 to 0.4 and finally to 0.3, and had been using from 0.3 phosphorus content for quite a considerable period. When Mr. Richmond was lecturing upon the same subject some years ago he was dealing with something which was larger than anything which had engaged the attention of Mr. West, but nevertheless something quite as important, *i.e.*, Diesel-engine liners, covers, etc. Certainly, however, the results he had obtained agreed very closely with what had been done on Diesel-engine liners, and with the work done by Wüst, of Aachen, and Mackenzie in the United States. The main consideration appeared to be that Mr. West had shown what others had not clearly indicated, namely, that the effect of phosphorus was to widen the scope of the carbon and silicon. This was a really important step in advance. The others were aiming at low carbon, and sometimes they did not get it and fell short.

Microstructure.

The explanation of Mr. West's low-phosphorus theory lay in the constitution. Therefore, it would have been helpful to show some micro-slides. The composition was not the end-all and the be-all of the casting; it was necessary to look at the microstructure. It was from this point of view that the 0.3 phosphorus content became of critical importance. The bigger test-bars really showed segregations as massive pieces of phosphide which was not desirable in any casting which was to be of use for resisting porosity. This state of affairs could be detected by an examination of the microstructure.

Mr. West, in reply, said that if engineers had specified a low phosphorus, it was because they had their attention concentrated upon the problem of heat resistance. It may have been stated in public that it was necessary to reduce phosphorus when cast iron was subjected to heat, but there did not appear to be any foundry literature which specifically related phosphorus with a reduction of porosity in castings. Porosity was a factor which concerned engineers during machining, and any signs of it caused a return of the casting. Refined irons were being sold around £6 per ton, and in most of them the phosphorus content was low, but this fact was not appreciated by the foundryman as a contribution to any good results obtained, as was proved by the common practice of mixing it with high-phosphorus iron.

He had read Mr. Richman's Paper, but he laid emphasis upon the use of low-phosphorus because of the duty the special iron had to meet.

He agreed that the micro-structure was of considerable help to the correct understanding of any metal constitution, already he had stated that constitution and structure must be co-related. He had not dealt at all with the effect of phosphorus upon the micro-structure of cast iron, because, like the subject of runners, mould material and gases, and their individual and collective effects upon the solidity or otherwise of castings, the field of speculation was so great that it was better to carry out a smaller amount of experimental work and come to some definite conclusion, even if it must be that, after investigating other factors relating to the same subject, that these conclusions have to be modified. However, he had two slides showing the phosphide eutectic network in the higher phosphoric iron in comparison to that with a very small amount.

Phosphorus Segregation and Soundness.

Mr. A. Jackson (Burnley) said that the Paper settled a question which had been troubling him for probably 15 years. When he was a journeyman in a foundry, some castings were wanted for which a high pressure was required and could not be obtained. The runners were changed, and various other expedients adopted, but no control could be established over the iron. There was a considerable amount of controversy about the matter. He had the idea then, and it still remained with him, that it was the phosphorus which was causing the shrink-holes in the neck of the casting. Working out the problem in theory, the failure was due to the segregation of the phosphorus. The phosphorus remained liquid much longer than other parts, according to the analysis of the iron, and, consequently, holes occurred through which the steam would pass.

The trouble with the foundryman was that, as a foundryman, he was not in a position, even if he was quite sure he was right in his own mind, to say definitely that he was right. He was always uncertain until proof was obtained by actual facts. This was the position in which the metallurgist came to his assistance. Matters were, however, somewhat difficult for foundrymen who were not working on high-test cast iron and were engaged with material which was not considered to be so important. He had, personally, tried, in closing the iron, the mixing of steel with it, for the ordinary tensile strength, but the difficulty was that a point was reached when a short run occurred, and then the castings were of less value than if they were porous.

"Life" and Low-Phosphorus Content.

Had Mr. West any suggestion to make with regard to the possibility of increasing the running power of iron and still reduce the phosphorus content? The phosphorus, of course, was present for plate work so that it was possible to run thin castings, but if it was reduced it was found that there were short runs. The reduction of the phosphorus, as had been so clearly emphasised, ought to be of practical value when dealing with castings of large section which could be run and in which there was trouble with shrink holes. In dealing with ½-in. section in which there was trouble with phosphorus, and where practically the same iron was used, was there any method of surmounting the difficulty of lowering the phosphorus and still maintaining the running required?

Mr. West said that the fundamental basis of reducing the porosity was owing to the shortening of the freezing range. The only thing which remained to do was to make sure that there was sufficient superheat to run the job. The addition of nickel or aluminium might help, but he did not think he would have recourse to them himself. It was known that the addition of aluminium would liven up some "dead" metal. The reduction of phosphorus shortened the freezing range, and hence when long and very thin castings had to be run the heat difficulty had to be overcome. If the heat could not be obtained from the cupola he would not like to use either aluminium or nickel because both of them were expensive. They were, however, the only two metals which he could think of at the moment which might be of any assistance.

Better Foundry Practice Needed.

Mr. Wynn (Newport, Shropshire) was pleased to find one member had expressed doubts as to the success of founding low-phosphorus referred to in the Paper. The difficulties, as Mr. West suggested, could be partially overcome by cupola practice. He had had considerable experience in casting low-phosphorus cast iron, and assured them that better foundry practice was essential. He found on many occasions that it was difficult to persuade customers that they were getting a better-quality casting. He was not entirely in agreement with Mr. West that low phosphorus would definitely give a stronger iron, but rather thought that the strength of cast iron depended more upon the formation and quantity of graphite present, and also that if one obtained a homogeneous liquid cast iron, and started graphitisation by some means other than raising silicon, then strength would definitely not depend upon phosphorus content. He agreed with Mr. West that he could only vary one element, *i.e.*, phosphorus, for the purpose of the Paper, but was sorry Mr. West had not experimented in order to ascertain if his conclusions still held when the carbon was 2.5 per cent.

Mr. West said he very much appreciated the force of the remarks which had been made, because he knew Mr. Wynn was dealing with a low-phosphorus iron, but this metal was not so very difficult to handle.

The method of melting iron at Mr. Wynn's works was different from that followed by the ordinary foundryman, who generally could not afford any extra expense in the way of capital expenditure for such a plant even if he were convinced that this was what he needed. The question of low-total carbon in relation to phosphorus was a matter which now called for some investigation, and it may be that an entirely different set of results might be obtained on this line of attack. However, it must not be lost sight of that to-day, with ordinary cupola practice and without expensive irons, there was definite assistance at hand at less cost than many foundrymen were paying for special irons. This assistance in the way of low-phosphorus irons, would very materially improve the quality of castings required to stand hydraulic pressure.

Segregation of Phosphorus.

Mr. Longden asked for the lecturer's views with regard to the segregation of phosphorus. It could be imagained that phosphorus would have to travel very quickly in order to become segregated in the middle of heavy castings. It was a question of the heating range. The actual elements in cast iron, according to the amounts present, increased or decreased the solidification range in all cases except that of sulphur. Consequently, if there was a lower total carbon in a commercial cast iron than was used at the present day one did not increase solidity. The same remark applied to silicon and phosphorus. He was a little doubtful about the effect of manganese. He should imagine, however, that there was one point where if manganese was increased there would be a tendency to greater solidity also.

With regard to phosphorus and its effect upon porosity, he was somewhat surprised to learn that it was a new experience to find that phosphorus reduced porosity. Some of them who had practised it for many years, and had made heavy castings having 3-in. and 4-in. walls, which withstood hydraulic tests, had been compelled to reduce the phosphorus to about 0.3 per cent. That feature could not be accomplished by lowering phosphorus alone, and the silicon had to be lowered also. Silicon was still the principal element by which there could be a control of mass as distinct from the smaller castings referred to by Mr. West. Phosphorus allowed a longer freezing range and a higher total precipitation of carbon. The greater the amount of graphite formed the greater the shell expansion of cast iron. He would have been glad if Mr. West had spoken further upon the effect of changing more factors. Could he, at some future date, extend his splendid experiments and cast his varying phosphorus contents into varying moulds—cast his varying phosphorus contents with varying temperatures? Probably

XUM

a great deal more information would be obtained in that way.

He agreed that refined irons as sold at the present day could be more or less substituted by refined irons made on the spot. It could be done at any works which had a metallurgist on its staff. He would like to suggest that with regard to the sample exhibited by Mr. West as showing porosity, he, personally, could produce such a sample at will in any cast iron through temperature differences.

A Composition of Segregates.

Mr. West said that it would naturally be thought that there was a concentration of the phosphide in the cavity shown in the sample exhibited. As a matter of fact, when the cavity was analysed it was found that there was less phosphorus than in the surrounding parts. Taking four ladles of metal, the following results were obtained: In one there was 0.64 per cent. phosphorus in the mixture. In the solid part of the test-bar 0.7 per cent., and in the spongy part 0.5 per cent. In another ladle there was 0.78 per cent. in the mixture, 0.8 per cent. in the solid part of the test-bar and 0.63 per cent. in the spongy part. In the higher percentages of phosphoric iron, 0.9 per cent. in the ladle, 0.93 per cent. in the solid part and 0.68 per cent. in the spongy part.

Complete analyses had not as yet been made, but he would not be surprised if the total carbon were not higher in the drawn part than in the solid. It was, therefore, necessary to consider any such differences in phosphorus percentages in the light of the whole composition. Mr. Longden had spoken about the use of low phosphorus in the casting of heavy cylinders. He did not suggest that foundrymen as a whole are entirely ignorant of the effect of phosphorus upon solidity, but he wished to emphasise that this knowledge should be spread abroad for the common good, and in view of its extreme importance and its effect upon the percentage of waster castings, the time was already overdue when such results should be published.

With heavy sections, he agreed that the control of silicon was just as vitally important as ever, but this element must be considered in relation to the amount of phosphorus contained in the mixture. Porosity was more likely to be connected with an iron having a long freezing range than one which had a restricted or shortened latitude of solidification. He was well aware of the views of Mr. Longden regarding the effect of mould materials upon the quality of castings, but as stated in the lecture he had definitely avoided any reference to this line of thought, owing to the complications which immediately arise in the handling of more than one phase of the subject.

The point had been raised that the amount of chill, due to green sand or any material which would cause an iron to chill off quickly, such as the use of denseners, which would reduce the time of solidification of cast iron, was bound to bring about beneficial results as far as solidity was concerned. The shortening of the solidification range, whether brought about by altering the composition of the metal or by the use of artificial means, would prevent a complete separation of graphite, which was the basis of porosity.

Compressed-Air Cylinders.

Mr. W. H. Keeble inquired whether the lecturer would interpret the values of refined iron solely in terms of chemical analyses. The lecture had been of considerable interest to him, because he had been concerned in the manufacture of compressed-air cylinders. His experience was that porosity occurred mainly through seepage and sweating from the graphite flakes and not from such large cavities or porous places as had been illustrated during the course of the proceedings. A 0.3 phosphorus iron, and under, seemed to be the best iron for avoiding porosity with the ranges of carbon and silicon mentioned. With compressed-air cylinders the usual silicon percentage was from 1.3 to 1.5, and with such a low-silicon iron and 0.3 phosphorus, coupled with a large amount of intricate cores, the metal would be impracticable to run. Consequently, the phosphorus was raised from 0.6 to 0.8. According to Mr. West, they were in the danger zone for porosity. This difficulty had been entirely solved by the use of a higher percentage of manganese, say, 0.9 to 0.91 per cent.

Mr. West, in reply, said there must be quite a lot of difficulty connected with the manufacture of cylinders, but taking a complicated design of motor-cylinder head, he was in a position to state authoritatively that in such cases where the number of cores inserted in the mould were considerable in number and differing in size, they did not affect the successful running of low-phosphorus iron, if sufficient superheat was obtained in the metal. He could assure the speaker that the hotter he produced cast iron, the better results he would obtain from every point of view, as that extra heat enabled the metal to rid itself of gas and dirt and also the structure of the iron was considerably improved.

With regard to the use of 1.3 per cent. silicon, he thought it would be found that with a phosphorus amount of 0.6 per cent., the margin of silicon that could be used would be very considerably restricted, and the danger would be that any fluctuations in the amount of this element in the composition would produce either hardness in the thinner sections or porosity in the junctures.

Mr. Longden said he had made malleable-iron castings, using white iron $\frac{3}{16}$ in. thick, from the cupola.

Mr. West said by lowering the phosphorus content to below 0.3 per cent., it would be found that the range of variation in the silicon content could be very greatly enlarged without any deleterious results.

Mr. Masters asked if the lecturer would state his cupola ratios.

Mr. West said, in answer to Mr. Masters, that a gentle breezy blast employed in the cupola gave better results from the heat production point of view than a fierce blast. For smaller cupolas he had found that a ratio of 4 to 1, and for larger cupolas 7 to 1, gave very satisfactory results.

Mr. Keeble asked whether refined iron could be interpreted in terms of chemical analysis alone.

Mr. West stated he must plead ignorance as to the full meaning of the term "refined" when applied to cast iron. It was easily understood that if one was considering a metal such as silver, the refining would be the freeing of the metal from dross. Refining of cast iron could only be applied to the graphitic carbon, and here this result could be achieved in every foundry by remelting.

The Effect of Phosphorus on Cast Iron.

Mr. H. Mills wrote: Mr. West has taken as the title of his lecture "The Effect of Phosphorus in Low Total Carbon Cast Iron." As I cannot have the pleasure of hearing his Paper I do not, of course, know exactly what percentage of total carbon he will class as low. I think, however, that the following notes from personal work and also previously-published results on the effect of phosphorus may be of interest. The question of the phosphorus permissible must be governed mainly by the nature of the stresses the castings have to withstand. Considering all irons in which the total carbon is under the eutectic point as "low," there is distinct evidence that phosphorus can vary over a large range without greatly affecting tensile strength, but that shock-resisting properties are affected to a much greater extent as phosphorus increases. This last point was very clearly shown by Mr. F. W. Rowe in a Paper published in The Foundry Trade Journal of December 20, 1923. The tests were carried out on the standard 120 ft.-lbs. Izod machine, but using 20-mm. square bars *without* notch. These tests showed that the impact strength fell from 29.0 to 10.50 ft.-lbs. as the phosphorus increased from 0.36 to 1.29 per cent. The complete analyses are as follow:—

	1.	2.	3.	4.
T.C.	3.31	3.21	3.17	3.28
G.C.	2.69	2.64	2.44	2.58
C.C.	0.62	0.57	0.73	0.70
Si	1.46	1.68	1.31	1.18
S	0.096	0.107	0.092	0.101
P	0.36	0.68	0.88	1.29
Mn	0.46	0.62	0.53	0.58
Impact strength (ft.-lbs.)	29.0	22.60	16.0	10.50

A series of tensile tests made by myself are as follow:—

	1.	2.	3.	4.	5.	6.
T.C. ..	2.85	3.02	3.20	3.05	3.35	3.22
G.C. ..	2.21	2.47	2.47	2.45	2.75	2.60
C.C. ..	0.64	0.55	0.73	0.60	0.60	0.62
Si	1.28	1.42	2.00	1.75	1.85	1.18
S	0.051	0.063	0.110	0.104	0.040	0.100
P	0.110	0.48	1.28	1.24	0.21	0.69
Mn ..	0.64	0.65	0.67	0.61	0.51	0.50
Tensile strength (tons per sq. in.)	16.86	16.30	16.10	15.44	15.35	14.90

The bars were cast $1\frac{3}{8}$ in. dia. and turned to 0.798 in. dia. for testing. The question of phosphorus and also total carbon was also very thoroughly dealt with by Prof. Rhead in his Paper "Strength and Properties of Iron Castings," given before the Manchester Association of Engineers in January, 1916, and published in The Foundry Trade Journal.

In this Paper it was clearly shown that for all-round strength, and especially in thick-section castings, low phosphorus was necessary as well as low total carbon and silicon. In conclusion it seems to me that the character of the castings and also their working conditions are determining factors in this question. For medium and uniform sections, when the castings have only to withstand tensile or compressive stresses, considerable variations in phosphorus seem permissible without detrimental results. On the other hand, in thick or irregular-section castings subjected to shock or bending stresses low phosphorus is desirable.

In reply Mr. West writes: I have your communication and am pleased to learn of the interesting results you have obtained yourself, but the object of the experiments carried out by myself was to determine the effect of phosphorus on porosity in cast iron. The mechanical properties of each mixture were determined from an interest point of view, and on this point we have compared your results with those obtained, and find comparative values with your impact figures and can confirm that there is a definite decrease in strength.

Regarding the tensile-test figures given by you, I find a difficulty in making a true comparison because of the fact that the constituents in your mixtures have such a wide variation.

There are two definite conclusions to be drawn from the results which were given at the Manchester lecture, and these are that up to 0.3 per cent. phosphorus, solidity of the cast-iron section is not affected, but immediately this amount is exceeded there is a gradual and definite increase in the shrinkage of the metal. In addition to this phenomenon, a wider range of silicon variation can be allowed with a lower percentage of phosphorus than when this element is in the vicinity of 0.5 per cent. and upwards.

As pointed out in the Paper, Wüst and Mackenzie both confirm the conclusions that can be drawn from the results published in my Paper, that up to 0.3 per cent. phosphorus, there is an increase in the tensile strength, after which it decreases as the phosphorus increases.

Training Foundry Salesmen.

By Eric N. Simons.

In a previous article the author discussed the choosing of salesmen, and indicated that in their training lay the next great essential to success. What are the steps in training that should be contemplated? Too often it is considered enough to have a nicely-spoken, pleasant lad. He is rushed hastily through the various departments of the foundry so that he may pick up a little technical knowledge—enough only too often to give him glibness rather than experience—given a few fatherly talks by the sales manager and the directors, then turned on to some abandoned or neglected district to see what are his powers of resuscitation. In the end, he may make a good salesman—and to his credit, be it said, he often does—but he will never make the perfect salesman.

No foundry salesman should be sent out until he has had at least two, and if possible more, years of sound works and office training. He should pass through the following stages:—(*a*) Laboratory, or drawing offices; (*b*) pattern shop; (*c*) foundry; (*d*) machine shop; (*e*) finishing shops; (*f*) inspection and testing departments; (*g*) general offices; and (*h*) accounting department. This may seem a stiff requirement, but not one stage in that progression is unessential. The advisability of covering the works departments thoroughly will be obvious, and need not be dwelt upon here. Nobody will seriously dispute the platitude that the more the salesman knows of processes and operations in casting manufacture, the better will he be equipped for selling. But readers may very well inquire why it should be considered advisable for him to pass through the offices and accounting department. The answer is manifold. One of the most frequent causes of irritation between salesmen and works is the inability of the former to realise what is possible in the way of organisation and what is not. The salesman with no office experience tends to regard the office staff and managers as folk who have a comparatively soft time, and do not stir themselves. If he sends in an order on a Friday, and it is not despatched on a day in the following week, he writes nasty letters accusing the order clerks of dilatoriness. Had he had the task of seeing an order through from its arrival until it reached the works departments, he might understand better what difficulties had to be faced.

How Office Training Helps.

Again, a salesman with purely technical and no business or commercial training is likely to be lacking in certain most important requirements. He will not be trained in expressing himself so as to be readily interpreted by clerks and office managers. He will have no notion of system in handling correspondence and filing letters. He will fail to realise the legal implications of his words and actions. A demand for intelligible reports or statements of expenses or analyses of markets will throw him into that fluster and commotion common to technical men with no business experience. And in a number of minor, but not necessarily negligible matters, he will waste money that could be saved. For example, if he has parcels to despatch, he will not know the cheapest way of sending them, nor will he always know what regulations have to be complied with. In sending telegrams, he will lack conciseness. He will not know all the ways in which money can be saved in travelling charges, telephone calls, etc. He will not realise how much time and work he can save at headquarters by making his reports in duplicate when they affect other representatives, or when two departments are interested in what he has to say.

So far as the accounting department is concerned, this can teach the future salesman how commission accounts are handled; why it is not always possible to give a salesman his commission total in five minutes, when he drifts in on a Saturday morning at five minutes before closing time; why it is sometimes necessary to press a good customer for payment of an overdue account; how credit notes and *pro forma* invoices and statements and the like are made out, and what they stand for; what the law of buying and selling is on certain important points; how the allocation of commission is decided; why it is necessary to obtain receipts for expense money paid out to a trustworthy representative, and many other matters he cannot but find useful later. Future overseas salesmen, for example, will learn much from having to handle branch office accounts.

Intensive Training.

In regard to this intensive training, another point is worthy of mention. Too often the young man chosen for salesmanship is told the work for which he is destined, and embarked upon his tour of works and offices in a perfunctory manner. He is, in each section, a mere supernumerary, turned loose, so to speak, to pick up what he can. This is all wrong. The actual workers in each section feel him to be a nuisance. They have to leave off their own work to attend to him, if he is avaricious for knowledge; they have the boring task of explaining to him what seem elementary points; and in the breasts of many doubtless lurks a dull resentment that he should have been chosen for this romantic lot rather than themselves (or, as sometimes happens, their sons or nephews). The youngster himself, having no recognised place in the department, feels uncomfortable, and dislikes to nag at his temporary colleagues for information; or, if he be lazy, he takes their perfunctoriness in good part, and fails to devote himself seriously to the task of learning, being content to have an easy time.

It appears essential that the budding salesman should (*a*) be given a definite fixed job in whatever department he goes to, a job for which he is responsible to an appointed chief, which he has to master for himself, and which has to fit in with all the other jobs, and (*b*) not be told too early the fate for which he is destined. This makes him take his work in whatever section he is appointed to seriously, prevents his colleagues from feeling jealous, and prevents his employers from committing themselves before they have had a chance of judging his capacities. If the youngster regards his first few changes of department as mere transfers, he will apply himself with diligence and enthusiasm to these successive chances of learning. In time, of course, he is bound to guess that his is a progression rather than a mere purposeless wandering, and to suspect what he is wanted for; but that is a very different thing from a definite promise which, whether fulfilled or not, will unsettle his mind, and if he has to be disappointed, make him unlikely to settle down in a minor post.

A Bad Beginning.

When he has passed through the various stages so far enumerated, many foundries would turn him out on to the road at once, as previously described. He would be given some district that nobody else could do anything with, or that the regular salesman had not time to bother with, and told to see what he could do with it. Probably he would find much discouragement, which is always bad for a young beginner. He would make mistakes, and have no chance of realising them, with the result that they would grow into habits. He would have little or no immediate supervision, which, with certain temperaments might be harmful. In short, the practice is a bad one.

It is far better to put a young man like this to work for a time under an older and more-experienced traveller. He could go about with the latter (careful choice of mentor being essential) for a few weeks to see how the castings were sold, how customers were approached, what talking points existed, how to overcome tough problems. Then he could be given the chance of doing the talking, being tactfully praised or criticised afterwards by his guide. Then he might be turned loose for a few months in the same man's district to do *pioneer* work, *i.e.*, not duplicating the older man's calls, but going to see people whom the latter had never had time to see, finding new customers, calling on out-of-the-way or unlikely people who might, or might not, have a use for the castings. He would not be given a commission, but only a salary, plus expenses stipulated not to exceed a certain sum.

When, in course of time, it became possible either to give him a district of his own of a reasonably-lucrative character, or to send him overseas, he would be a trained and confident salesman, not a raw novice with everything to learn. The foundry that chooses its future salesmen well in advance of immediate requirements, trains them thoroughly on the lines indicated, and initiates them gradually into this most important business of foundry selling, is the one that is going to get the orders. No correspondence courses, no sales managers with blackboards and chalk, can make salesmen as efficient and as formidable as will the methods outlined.

Catalogue Received.

Foundry Sand and Core Making.—The Fordath Engineering Company, Limited, of Hamblet Works, West Bromwich, has sent us an advance copy of their latest catalogue, which covers their laboratory service, Glyso core compounds, Rotoil sand mixers, rotary core-making machines, refractory blackings and furnace linings. In the Foreword the compilers have used the spelling "ferreous." This is perfectly correct, but unusual, and we should not regret its demise. The laboratory activities are mainly devoted to microscopical, chemical and analyses of materials, and physical tests for sands, plus experimental work. The catalogue convinces one that the company is well placed for the investigation of defective castings. The section devoted to Glyso really does assume a fighting attitude. It gives no quarter and asks for none. We have but one grumble, and that is the trite reference to Cinderella. We wish that she should now be regarded as Queen Anne, as her continued existence, or reference to, ever having had any connection with the foundry industry, does founding a disservice. The matter explanatory to the Rotoil mixer could not very well be better set out; in fact, we have never yet seen a more comprehensive description of any machine. For instance, we should say that the two pages devoted to the multiple-rotary core machine is typical of the average catalogue description. Next to the last page carries a description of two kinds of refractory blackings—one for ferrous and one for non-ferrous mould facings, and two grades of cupola refractories—Monocrete and Supercrete. The catalogue contains 40 well-illustrated pages. From an artistic point of view only, one mistake has been made, and that is that insufficient white border has been left around the green-tinted pages. More white would have thrown them better into relief.

We understand that copies of this edition are now available to our readers, and we are sure by availing themselves of this offer, they will have an opportunity of receiving a better appreciation of their own problems and a possibility of their solution.

XUM

Chicago Convention.

Plans for the 1933 Annual Convention of the American Foundrymen's Association are now taking shape under direction of the Programme and Papers Committee, and already indicate that this year's meeting will be different and distinctive in many ways. Special effort is being made to give foundrymen the opportunity to see, hear and discuss what concerns them most to-day—how to produce quality cast metal parts marketable at a profit.

At the Foundry and Industrial Exhibition, to be held in the Exhibition Hall at the Stevens Hotel, many new products, new equipment and the latest improvements in standard equipment, will be shown and demonstrated. Session hours throughout the week are being arranged so that ample time will be left open for inspecting the exhibits.

Dramatising Foundry Costs.

Brief announcement has already been made of one original Convention feature, the four-act play on foundry costs. This play will dramatise a foundry's experiences and adventures in determining on and setting up a workable, efficient cost system. The event will be staged the afternoon of June 20 and is being prepared under direction of the A.F.A. Cost Committee, with the co-operation of A. E. Grover, cost consultant of the Grey Iron Institute, Cleveland. Foundry managers and executives are urged to attend.

Good Housekeeping to be Stressed.

"Foundry Housekeeping" is the general title of a conference scheduled for the afternoon of June 22. Under triple sponsorship of the A.F.A., National Safety Council and National Founders' Association, the conference programme will consider problems vital to the foundry industry. Recognised authorities will review the various phases of dust hazards in the foundry, and opportunity for informal discussion will be given.

Trends in Materials Handling.

A third meeting of general interest is a joint session on materials handling, sponsored by the new joint committee of A.F.A. and the Materials Handling Division of A.S.M.E. Special consideration will be given materials handling problems of the small foundry under present operating conditions.

Steel Castings Problems.

Three sessions will be devoted to steel founding, one dealing chiefly with test methods and including an unusual Paper on impact testing. The other two sessions will comprise a symposium on alloys in steel castings. Alloys of chromium, nickel, vanadium, molybdenum and copper will be discussed.

Grey-Iron Castings.

An informative session on cast iron will cover specifications and tests, to be held June 23. This event is sponsored jointly by the A.F.A. and A.S.T.M., and is intended to emphasise to foundrymen the practical significance of specifications and how tests can be made most reliably. The important symposium on grey-iron castings is scheduled the week following the A.F.A. Convention, during the A.S.T.M. annual meeting. This symposium is the third of a series of cast metals held under joint auspices of A.F.A. and A.S.T.M. These reliable and up-to-date compilations of data and statistics are of special value to both castings producers and buyers, and have added greatly to existing engineering information on the usefulness of cast metals.

Malleable Iron Founding.

Two sessions on malleable-iron foundry problems are being arranged, one a round-table luncheon meeting, June 21. Mr. J. H. Lansing, Danville Malleable Iron Div. of Allith-Prouty Company, Danville, Ill., and Mr. H. W. Highriter, Frazer & Jones Company, Syracuse, N.Y., have accepted appointment as chairman and vice-chairman, respectively. Interesting Papers on malleable-iron production will be presented at the second session in a programme as yet unannounced.

Non-Ferrous Castings.

Three sessions are scheduled for the Non-Ferrous Division's share of convention activities. One will be a round-table luncheon meeting at which Mr. H. M. St. John, Detroit Lubricator Company, Detroit, will preside.

The Century of Progress.

As a background to this comprehensive programme, the Century of Progress exposition will open on June 1 in Chicago. The Stevens Hotel, A.F.A. Convention headquarters, is close to the Lake Front so that visitors can attend the World's Fair conveniently and yet attend all convention sessions of interest.

TENTATIVE PROGRAMME.

Tuesday, June 20.

9 a.m.—Opening of Foundry and Industrial Exhibition.
8.30 a.m.—Shop-operation courses.
10 a.m.—Formal opening session.
1.30 p.m.—Foundry costs: Dramatising a foundry's experience with costs; staged by A.F.A. Costs Committee.
2 p.m.—Conference of foundrymen and engineering school representatives.

Wednesday, June 21.

8.30 a.m.—Shop-operation courses.
10 a.m.—Grey iron—electric melting.
10 a.m.—Steel—alloys in steel castings (1st session).
10 a.m.—Non-ferrous—general foundry practice.
10 a.m.—Malleable castings.
12.30 p.m.—Malleable Iron Round-Table Luncheon.
12.30 p.m.—Steel Foundry Luncheon; session on alloys in steel castings.
12.30 p.m.—Non-ferrous Round-Table Luncheon.

Thursday, June 22.

8.30 a.m.—Shop-operation courses.
10 a.m.—Steel founding—tests.
10 a.m.—Non-ferrous castings.
10 a.m.—Grey iron—general practice.
1.30 p.m.—Annual business meeting.
2 p.m.—Foundry Housekeeping: Joint meeting with National Safety Council and National Founders' Association co-operating.

Friday, June 23.

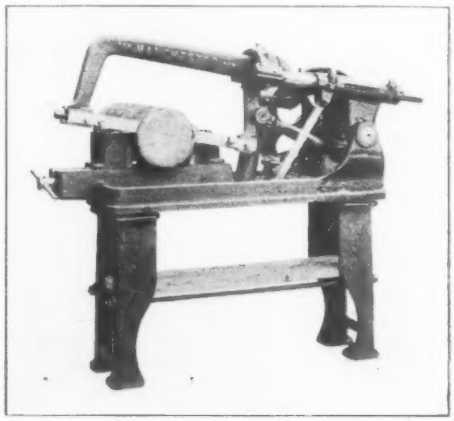
10 a.m.—Sand Research.
10 a.m.—Grey-iron specifications and tests: Joint meeting with American Society for Testing Materials.
10 a.m.—Materials handling—Sponsored by joint committee of A.F.A. and Materials Handling Division of American Society of Mechanical Engineers.
5 p.m.—Closing of Foundry and Industrial Exhibition.

G.W.R. 20-Ton Wagons.

The Great Western Railway Company have received applications for more than 5,000 20-ton wagons, the maximum number which they offered to provide under the scheme recently announced. Orders for a total of at least 4,000 wagons have been placed with the following wagon-building firms, and those for the remainder will follow shortly:—Fairfield Shipbuilding & Engineering Company, Chepstow; Welsh Wagon Works, Limited, Maindy, Cardiff; Gloucester Railway Carriage & Wagon Company, Limited, Gloucester; Birmingham Railway Carriage & Wagon Company, Limited, Smethwick, Birmingham; Charles Roberts & Company, Limited, Horbury Junction; Metropolitan-Cammell Carriage & Wagon Finance Company, Limited, Saltley, Birmingham.

The "New Manchester" Saw.

To meet the requirements of those engineering shops where there is insufficient work to justify the use of a heavy production hacksawing machine, but where a reliable, straight-cutting sawing machine is definitely needed, Edward G. Herbert, Limited, of Atlas Works, Levenshulme, Manchester, have just put on the market a new light machine of 6 in. by 6 in. capacity. The "New Manchester" saw is claimed to be the only light sawing machine which has an automatic relief on the return stroke by means of an adjustable oil dashpot. Further, the "cutting on a corner" method first patented and subsequently developed on all E.G.H. sawing machines, obviates the use of weights.



The "New Manchester" Saw.

A T-slotted table 18 in. long by 4 in. wide is cast integral with the bed of the machine. A strong screw vice with swivelling jaws enabling 4-in. stock to be mitred at 45 deg. is supplied as standard. Other details of the machine include the provision of two parallel square steel slide-bars placed diagonally in the slides to secure self-alignment, thus materially assisting in maintaining rigid guidance of the saw frame and consequent straight cutting over a long period of time. The drive is by single pulley 14 in. dia. and 2¼ in. wide fitted with clutch, and an automatic knock-off is provided at the finish of the cut. The main bearing is phosphor bronze and of ample length, the crankshaft is 1¼ in. dia., and the crankpin and frame pin are hardened and ground. A tool shelf is provided in the base of the machine, which is designed to run at 100 r.p.m. and 14-in. blades are used. The net weight of the machine is 280 lbs.

Richardsons, Westgarth-Brown Boveri, Limited.

The long and close association in the steam-turbine field which has existed between Messrs. Richardsons, Westgarth & Company, Limited, and Brown Boveri & Company, of Baden, has been recently extended by the acquisition of additional licences from the Swiss company for the manufacture of turbo-compressors and blowers for all purposes, including those for Diesel and aeroplane engines; main and exhaust steam marine propelling machinery, either with mechanical or electrical transmission; equipment for marine Diesel-electrical propelling machinery, and auxiliary turbines for all purposes for use on board ship. Richardsons, Westgarth are therefore now in a position to manufacture such machinery at their Hartlepool works to Brown Boveri designs, in addition to the steam turbine and electric generators previously made there. A joint subsidiary company with the title of Richardsons Westgarth-Brown Boveri, Limited, is responsible for all sales in Great Britain of Brown Boveri and other allied products of the Hartlepool concern.

Does Science Help the Foundry Industry?

(*Concluded from page* 175.)

Bunting believed half of what he had said. He hoped Mr. Bunting was wrong with the point of view that the scientists were as good as the foundrymen. As science had to help the foundryman, this squabble between founders and chemists had generally come about because of the attitude of the foundrymen to the chemist in the foundry. Foundrymen did not properly realise that the important factor was the training of the chemist and not his knowledge. The chemist was trained to work to facts, and unless he had those facts he would not give a definite opinion, and would say he was "not certain" or he "believed it was so." The chemist had the training which assisted him in making deductions that the ordinary man did not get. To take an example:—A man in a core shop may be using a grease tin as his measure for binder. By some means the tin gets misplaced, and the man will take up a cocoa tin and carries on with his measuring. The scientist would not let one do that. He thought the scientist used more logic than the foundryman. There was no doubt that John Surtees was a scientist. When a man was so successful he must have made proper deductions from the facts accumulated.

Mr. Sanders had cleared up the point of silicon, and he (Mr. Peace) thought all scientists were agreed that in grey iron the essential element was the carbon and its distribution, and the other elements were of minor importance except as they affected the carbon. If Mr. Bunting were making a good heavy job he would see that he was having the correct silicon.

Why Scientific Opinion Differs.

This point of differences by scientists differing may be illustrated by the wireless science. One engineer designs a circuit, and when the set is assembled it can be tuned in to a certain station. Another set designed on an entirely different system will tune in that station equally well.

There was a certain amount of resentment still existing over the question of sand, and he supposed that came about because the foundryman saw nothing in sand but sand. There was also the fact that core oils were weird and wonderful, and whilst the chemist would want much time to tell the composition of a core oil, and that knowledge would be of little use to the foundryman, he could give tests to show the oils had constant physical characteristics. Finally, he thought the chemists wanted more assistance from the foundrymen.

Mr. T. A. Spiers (Leicester) said he believed in the scientist's side. The scientists received their training in ideal conditions and the foundryman did not. In his opinion the scientist should betake himself to the foundry and train the foundryman.

Mr. Hallamore (Burton) agreed, as a practical man, to the usefulness of science in the foundry, but objected to the great expense of science. He could not agree that the pattern-maker decided how jobs were to be made; very often the moulder had to alter the patterns to make the castings.

Mr. Orme (Leicester) could not agree with either speaker. He had worked in foundries with both scientific control and without, and he thought science to be essential, but there should be no antagonism between science and practice.

What's in a Name?

Mr. Driver (Loughborough), as an engineer, said he was in a peculiar position. His scientific friend said he was a practical man, whilst the foundryman classed him as a scientist. He had heard of draughtsmen being called fools and he occasionally agreed with that statement. It was so easy to put down lines on paper, without any thought as to how the job was to be manufactured. He had a great respect for the old-time foundry craftsman. He instanced a case during his student apprenticeship of making some engine-cylinder castings. These the foundry section made in a hard iron to withstand the wear, but were rejected by the machine-shop section as unmachinable, and the old foundryman set to and made a tool capable of cutting the cylinders. Those castings turned out to be excellent and no doubt some of them were still in use. Mr. Bunting, he said, had let himself down. He had attacked the scientist and then gone on to talk of silicon, carbon, eutectics, etc., showing himself to be something of a scientist. Mr. Bunting was a practical scientist.

Mr. Hillman (Leicester) said he had a long experience as a practical moulder and he had come upon difficulties. Since being in charge of men he had come on those same difficulties, and had realised how much science helped in the solution of those difficulties. Science helped the practical man far more than he realised.

Mr. Bigg, summing up, said we had to realise that the scientist was to an increasing extent taking control. He was not condemning the foundryman for that. We were all scientific; science was the ascertainment of fact. He did not claim to be a foundryman, but if he could criticise, it would be that the foundryman did not have the knack of ascertaining the real facts; they wanted somebody to help. The chemists, draughtsmen and engineers should be looked upon as aids in the efficient production of the foundryman's job.

Mr. Stevenson (Nottingham), proposing a vote of thanks to Mr. Sanders and Mr. Bunting for a very successful evening, said he failed to see how any foundry could exist without scientific help. If Mr. Bunting complained of the lack of opportunity for the moulder, it was the moulder's own fault. The Institute was founded in 1904 by some half-dozen foundrymen who wanted to know something of their job. Why was it not started 50 years before? That evening's debate had brought out many interesting facts.

Mr. Pycroft (Derby) seconded, and the meeting applauded the principals.

Mr. Bunting expressed his thanks. There was one true word, he said, mentioned by Mr. Peace, and that was that he did not believe Mr. Bunting meant half of what was said; he, Mr. Bunting, did not believe 90 per cent. of it. His had been the part of the "stump" orator, but he hoped it had raised a useful discussion.

Mr. Sanders also expressed his thanks.

B.C.I.R.A.

At a Council meeting, held in Birmingham last week, of the British Cast Iron Research Association, the following new members were elected:—

Ordinary Members.—Bayliss, Jones & Bayliss, Limited, Wolverhampton; Cardiff Foundry & Engineering Company, Limited, Cardiff; Grimwade & Allen, Footscray, Victoria, Australia.

Trade Member.—Quiksol Products, Limited, London.

The General Electric Company, Limited, has created £3,500,000 of 4½ per cent. first mortgage debenture stock for the purpose of redeeming at 105 per cent. on September 30 next the outstanding balance of 5 per cent. debenture stock. Holders of the latter will be offered the right to convert their holdings into an equivalent nominal amount of the new security, receiving a cash payment of 7s. 6d. per £100 of stock to adjust interest. They, with the holders of the 6½ per cent. and 7½ per cent. preference shares, may also apply for such portion of the new stock at 105 that is not absorbed by the conversion.

Making a Chemical Pan.

(*Concluded from page* 176.)

core iron. It is just a circular ring with four gas-threaded nuts cast in equidistantly and also ringed round with ¼-in. irons cast in vertically.

Coremaking.

Fig. 6 shows the cast-iron core box and tackle used in a sectional view. The spindle was put in the spindle centre, which was fastened to a levelled plate. The core box or former was put on the plate and centred and the four pieces of wood to form the spaces between AA and BB put in and a layer of oil sand put on them. The core iron, which was clay-washed, was put in and the prongs bent to shape, and the strickle put on and run round to see if the prongs were all clear. It was then rammed up and strickled to shape. The top of the prongs were interlaced with hemp string similar to a wicker basket. It was vented by means of wax string which was led to the four nuts cast in the core iron. The spindle and board were then removed and the plate on which the cor box and core rested was put on a stove carriage and dried. When dry, the inside of the core was finished and blacked and stoved. Then it was brought out of the stove and the inside of the core filled level with black floor sand and a plate fastened to the core box. Finally it was rolled over until the core box rested on the plate dome upwards. The core box was then rapped and removed and the core finished and blacked and dried ready for using.

Sands Used.

The sand used was 50 per cent. dried red sand and 50 per cent. dry sea sand and mixed with oil in emulsion form in the ratio of 1 of oil to 20 of sand. The facing-sand mixture for the mould was 49 per cent. of red sand, 49 per cent. of black floor sand and 2 per cent. of horse-manure, giving a facing sand which was free-venting and suitable for skin-drying. The parts of the mould which were skin-dried were from the base of the mould and core to about 12 in. up, and also the dome part of the mould was skin-dried.

DISCUSSION.

Mr. J. Hogg said he did not care for wax vents, as they were liable to cause soft places in the core. He preferred to use ordinary string, which was drawn out when the core was dry.

The Lecturer replied that no soft places were discovered in the jacket core when dry, but no doubt that ordinary string was quite as good.

Mr. J. Pell said that he did not think it was necessary to make a cast-iron core box, as the core could have been made in the reverse manner on a sand-dummy, and he also did not like the idea of mixing bad-venting sand, such as red sand, with sea sand.

Mr. Meadowcroft replied that at the time the job was made further orders were expected, so a good job demanded good tackle, and suggested it would have been awkward to make the core in the way indicated by Mr. Pell; as for mixing red sand and sea sand, well, the casting spoke for itself; it was a good one.

Mr. G. Barnes asked how the author knew when to introduce the warmer metal in the dome-base runner?

The Author pointed out that as the runner was cut in the joint at the base of the dome, a man standing on the top part could see for himself when the metal, which was entering the mould by way of the down runners, reached the level of the base of the dome. It ran along the dome runner and then showed itself to the man watching, who gave the signal for the hotter metal to be poured in at this point.

On the proposal of Mr. L. Wharton, seconded by Mr. Robinson, the author was accorded a hearty vote of thanks, which Mr. Meadowcroft acknowledged.

XUM

This Week's News in Brief.

Trade Talk.

The South Staffordshire Ironmasters' Association has altered the date of the Birmingham quarterly meeting from April 13 to April 6.

The blast furnace which has been under reconstruction at the Dowlais Works, Cardiff, of the British (Guest Keen Baldwins) Iron & Steel Company, Limited, was blown in last week.

Messrs. Sir W. G. Armstrong, Whitworth & Company (Engineers), Limited, Scotswood, Newcastle, have received an order from the London, Midland & Scottish Railway Company for a Diesel-electric shunting locomotive of 250 b.h.p.

Messrs. Colvilles, Limited, Motherwell, have received an order to supply 65,000 pairs of special-type fishplates for South African Railways. Messrs. North West Rivet Bolt & Nut Company, Limited, Airdrie, have an order for 80-lb. rail sleeper bolts for the same railways.

All the debts having been paid in full, with interest of 4 per cent., the receiving order dated December 13, 1932, against Mr. Richard Sydney Clayton, carrying on business at 7A, Pitt Street, Norwich, ironfounder, has been rescinded, and the adjudication dated December 14, 1932, annulled.

Garton & King, Limited, ironmongers, builders' merchants, ironfounders, stove and range manufacturers, heating, lighting and domestic and sanitary engineers, announce the discontinuance of their retail business at 190, High Street, Exeter. Their foundry and engineering works at Waterbeer Street will be carried on as usual.

It is reported that the Union Minière du Haut Katanga has decided to increase from April 1 its output of copper from 40,000 to 56,000 tons per annum. The new output figure will represent 50 per cent. of the Haut Katanga capacity. The increase is largely due to an expected revival in the demand for copper from the Far East.

The London office of Messrs. David Brown & Sons (Huddersfield), Limited, has been transferred to Bush House, London, W.C.2, and is under the management of Mr. A. Avison. The entrance hall of the suite will serve as an exhibition room where typical products—worm, spiral bevel, helical and spur gears, speed reducers, etc.—will be displayed.

A Bill providing for the reorganisation of the shipbuilding and engineering firm of Burmeister & Wain, of Copenhagen, was introduced in the Danish Folketing recently by the Minister of Commerce. The scheme, which takes effect from March 1, provides for the business to be divided into two parts—one to carry on the business as a new company and the other to act as a liquidation company.

It is officially announced that after extensive reconditioning the Skinningrove iron and steel works, Saltburn, will be restarted at the beginning of next month and work will be provided directly and indirectly for some thousands of men. Of the five blast furnaces two will be immediately put into operation, the coke ovens, melting shop and rolling mills will be restarted, and the Loftus mine will be reopened for the supply of ironstone.

The Irak Petroleum Company, Limited, have placed the complete contract for main oil line pumps with Messrs. Worthington-Simpson, Limited, Newark-on-Trent. This important order comprises forty-five 6¾ in. by 24 in. horizontal duplex double-acting outside-packed plunger-forged fluid-end pumps, with single reduction of helical gear and all moving parts entirely enclosed to prevent the ingress of sand. The pumps will be driven by 500-b.h.p. Diesel engines, delivering against a line pressure of 800 lbs.

Messrs. Harland & Wolff, Limited, have received an order from the Bombay Steam Navigation Company, Limited, to build a passenger and cargo boat. The vessel, which will be 200 ft. long, will be of the same type as one at present building for the same owners at Govan. The hull of the vessel will be constructed at the Clyde yard, Govan, and the machinery, consisting of two sets of triple-expansion engines with double-ended boilers suitable for coal- or oil-firing, will be constructed at the firm's Belfast works.

Obituary.

Mr. John Cameron Walker, director of Messrs. Dobbie Forbes & Company, Limited, Larbert Foundry, died at his home in Larbert on March 4, aged 71.

Mr. T. F. Wilkinson, managing director of Messrs. T. F. Wilkinson & Company, Limited, textile machinery makers, of Coventry, died on February 24, aged 76.

Mr. Archibald Bowie, a former manager of the Solway Ironworks at Maryport, died on Saturday, February 25, at the age of 83. Mr. Bowie was appointed to manage the Solway Works in 1903. He retired about 23 years ago.

A foreman, Mr. John Morrison, died as a result of an explosion of an acetylene generator at the works of Messrs. Wass & Son, Limited, Fountainbridge, Edinburgh. The generator was being used for metal-cutting work, and it appears that Morrison had been cleaning the generator, in which some gas had accumulated. He was struck by pieces of the shattered metal and died shortly after.

We sincerely regret to announce the death of Mademoiselle Marcelle Ronceray, who died last Sunday, aged 23. Miss Ronceray is the only daughter of Mr. Eugene Ronceray, the President of the French Foundrymen's Technical Association, and because of her participation in many international congresses and her charming personality had a wide circle of friends amongst foundrymen of all nations.

Personal.

Mr. W. Y. Buchanan, who is a member of the Institute of British Foundrymen Sands Committee, has resigned his position as metallurgist to Messrs. the Mirrlees Watson Company, Limited, Glasgow, on appointment to a similar position with Messrs. John Lang & Company, Limited.

Catalogue Received.

Foundry Requisites. — Messrs. Foundry Equipment, Limited, of 15, Victoria Street, London, S.W.1, have now prepared what will ultimately be three sections of their proper catalogue. We were asked to regard these of a provisional character, and to refrain from commenting upon their make-up from the point of view of an example of modern publicity. The first one we examined describes and illustrates a line of armoured wooden snap flasks, aluminium and wooden slip flasks and adjustable pouring jackets. The second we perused covers a very comprehensive line of compressed-air accessories for the foundry, and includes pneumatic rammers, air-hoists, vibrators, blowing-off nozzles, rotary grinders, air receivers, compressors and hose pipes and fittings, and chisels. The last one is devoted to sand-handling plant, and opens with a very intelligent appreciation of modern sand-preparing problems and the efforts the firm has made to rationalise procedure. This occupies two pages of matter well worth study. The balance, a matter of ten pages, describes and illustrates the machinery they make for sand preparation. The range is very complete, and includes gyratory and rotary sand sifters, reciprocating screens, ball mill and screen combined, sand revivifier, disintegrators and sand mills. We were particularly interested in the apparatus shown on page 7, which illustrates and describes a small centralised sand plant, consisting of a rotary screen, an elevator, a semi-automatic sand mill, and, finally, a sand thrower. An oil core-sand mixer, of the box type fitted with two pairs of right- and left-hand worms, forming a screw, completes this section. It is stressed throughout the pamphlets that all the machines described are of British manufacture throughout.

Company Meeting.

Mather & Platt, Limited.

The annual meeting of Messrs. Mather & Platt, Limited, was held in Manchester on February 28. Mr. L. E. Mather (chairman of the company), who presided, said that it was with satisfaction that they were able to show better figures than last year, with a slightly increased amount available for distribution. The circumstances, however, did not warrant the payment of larger dividends. One development arising out of their recent efforts to expand their business which he had to report concerned the canning machinery which they started to manufacture some two years ago. To strengthen their position they decided to enter into an agreement with the principal organisation in the U.S.A.—the Food Machinery Corporation of California—for the manufacture and sale of canning equipment. For this purpose they had formed a selling company called "Food Machinery (M. & P.), Limited," as a joint undertaking with their American friends for the sale of machinery manufactured at Park Works throughout the British Empire and certain foreign countries. This placed them in a good position in this industry, which had become of increasing importance. It should not, however, be assumed that they had already made big profits from this new venture—on the contrary, they were only in the development stages, and, as every manufacturer knew, the returns were small until the initial spade work had been carried out. Another development which should have far-reaching results was in connection with fire protection. During the last year they had perfected a device for safeguarding the serious and dangerous fire risks which modern science had brought into existence by the various and many uses of oils, varnishes and all volatile spirits in workshops. They had given their new system, which was covered by a master patent, the name of "Mulsifyre," to signify that the effect was produced by the emulsification of the surface of the burning liquid which was brought about by bombardment with fine jets of water. Tests had been witnessed by the Board of Trade officials and its application to the engine rooms of oil-fired ships had received their approval.

New Companies.

Workington Iron & Steel Company, Limited, 17, Westbourne Road, Sheffield.—Capital £100 in £1 shares.

Coseley Brassfoundry, Limited, Woodsetton House, Woodsetton, near Dudley.—Capital £1,500. Directors: W. J. and Phyllis Gough.

Dawkins Enamels & Foundry Company, Limited, Hall Road, Wednesfield, Staffs.—Capital £20,000. Directors: W. A. and Mrs. E. M. Dawkins.

De Renzi, Holmes & Company, Limited, Fox's Lane, Wolverhampton.—Capital £2,000. Electric switchgear manufacturers. Directors: V. I. Holmes and Agnes M. L. de Renzi.

Trionite, Limited, 8-10, Bagnall Street, Hanley, Stoke-on-Trent.—Capital £3,000. Iron and brass founders. Directors: C. V. and F. Plant, C. and D. H. McNeal, W. R. and R. T. C. Jones.

Distington Hematite Iron Company, Limited, 17, Westbourne Road, Sheffield.—Capital £100 in £1 shares. Directors: H. P. Morrison and Gerald Sturt. The United Steel Companies, Limited, may appoint additional directors.

Company Reports.

James Booth & Company (1915), Limited.—Net profit, £52,439; brought in, £16,934; dividend of 15 per cent. on the ordinary shares; to reserve, £15,000; carried forward, £17,847.

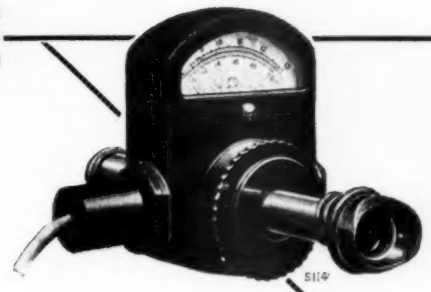
Clarke, Chapman & Company, Limited. — Net profit, £25,228; brought in, £13,635; depreciation on buildings, plant and machinery, etc., £4,345; preference dividend, £4,889; final dividend of 1½ per cent. on the ordinary shares, making 3¾ per cent.; carried forward, £11,541.

Mr. John N. Reid, works manager of Torwood Foundry, Larbert, is to be honoured on completing his 50th year of service with the firm.

Cantor Lectures.—The Cantor Lectures this year will be given before the Royal Society of Arts in London on March 6, 13 and 20. The subject is "Welding and Allied Processes for Engineering Purposes" and the lecturer will be Mr. Arthur Stephenson, M.I.Mech.E. (Vice-President), of the Institution of Welding Engineers.

AN INEXPENSIVE PYROMETER

for measuring temperatures
from 700° C. *to* 2,100° C.



Hundreds of these pyrometers are in constant use all over the world. They are extremely robust and give accurate readings even when used by unskilled observers.

PORTABLE **ACCURATE**
SIMPLE TO USE **QUICK IN ACTION**
SELF-CONTAINED **INEXPENSIVE**

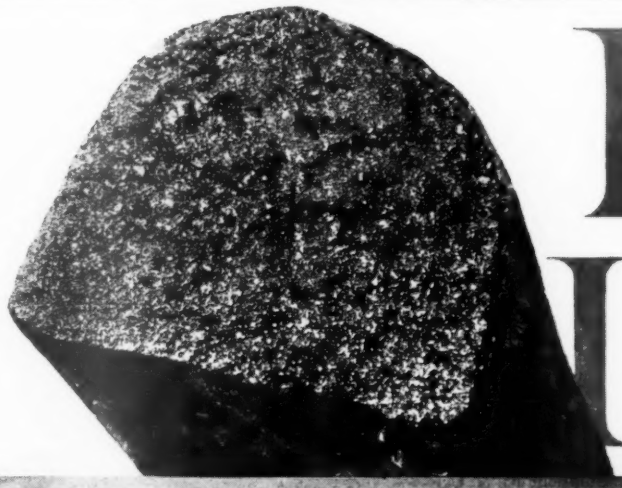
Fitted with interchangeable lamp unit.

Complete equipment showing method of using pyrometer.

Full details are given in our illustrated
LIST No. 990-F
which we will gladly send on request.

CAMBRIDGE
INSTRUMENT Co LTD

WORKS:- LONDON & CAMBRIDGE
Head Office & Showrooms:- 45, GROSVENOR PLACE LONDON S.W.1.



PIG IRON

Manufacturers of FOUNDRY, BASIC and HEMATITE qualities. Delivery from stock.
Booklet giving analyses, etc., will be sent on request.
DORMAN LONG & CO. LTD., MIDDLESBROUGH

DORMAN LONG

Raw Material Markets.

Although a more optimistic tone prevails generally in the iron and steel markets, the process of recovery is still retarded by the lack of activity in many of the consuming industries. The demand for pig-iron is maintained at a fairly steady rate, especially in the Cleveland area, where substantial home sales have recently been negotiated. As regards finished steel, somewhat better conditions are reported in one or two sections of the consuming trades. More shipbuilding work is now being given out to the foundries, whilst the placing of orders for 17,000 tons of rails and fishplates by the South African Railways is also an encouraging factor.

Pig-Iron.

MIDDLESBROUGH.—Conditions are much improved in the local market. The zone price system is now working smoothly and buyers are not hesitating to cover their immediate and forward requirements. At the present moment there is only one Cleveland furnace producing foundry iron, and stocks are being drawn upon considerably. Two furnaces are to be restarted at the Skinningrove works at the beginning of April, after reconditioning. One furnace is also to be restarted by Messrs. Dorman, Long on ferro-manganese at South Bank. To local consumers the delivered price of No. 3 Cleveland G.M.B. pig-iron is 62s. 6d., No. 1 foundry and silicious are at 65s. and No. 4 foundry and No. 4 forge at 61s. 6d. per ton. Delivered Glasgow, the quoted price of No. 3 G.M.B. is 62s. 9d., with the same differences for the other grades, delivered North-East Coast 64s. 6d., and delivered elsewhere 69s. per ton.

It remains as difficult as ever to negotiate export sales for East Coast hematite, but the home demand is gradually expanding, owing to the increasing activity at the steelworks, particularly in the South Wales area. Market quotations remain at 59s. per ton for mixed numbers, although shading is possible, and 59s. 6d. for No. 1 quality.

LANCASHIRE.—Sales of foundry iron remain moderate, few forward contracts of any importance being reported. The consumption of foundry iron cannot, however, be taken as a criterion of activity in the foundry industry, owing to the increasing inroads being made by scrap iron; a tendency particularly noticeable in the Lancashire area. For pig-iron, offers are well held on the basis of 67s. per ton for Staffordshire, Derbyshire and North-East Coast brands of No. 3, delivered to users in the Manchester district, 65s. 6d. for Northamptonshire, 62s. for Derbyshire forge, round 82s. for Scottish foundry, and 80s. 6d. for West Coast hematite, East Coast hematite being on offer at about 5s. less.

MIDLANDS.—Pig-iron buying fails to show any upturn. Conditions remain patchy in the consuming trades. Prices are at the same level, namely, 62s. 6d. for Northants No. 3 and 66s. for Derbyshire, North Staffordshire and Lincolnshire No. 3, delivered Birmingham and Black Country stations, with the standard differences for other grades. Scottish iron comes into this district steadily in limited quantities at prices ranging from 83s. 6d. to 85s. 6d. net, delivered. Iron with varying low percentages of phosphorus can be obtained at from 70s. to 80s. West Coast hematite remains at the official level of 84s. 6d., but East Coast and Welsh prices are not so steady, and vary, according to analysis and tonnage, from 74s. 6d. to 80s. per ton.

SCOTLAND.—The aggregate consumption of pig-iron is not very great at the moment, the foundries being extremely short of work, although some relief is to be expected in the way of shipbuilding work. There is no change in prices and the official minimum of 65s. for Scottish No. 3 foundry iron is still in force, with 2s. 6d. extra for No. 1. The light-castings section of the trade continues to be only moderately employed and in very few cases is a full week being worked. For No. 3 Middlesbrough the quotation is 62s. 9d. f.o.t. Glasgow area and 59s. 9d. f.o.t. Falkirk area, while other English irons are obtainable at 2s. 3d. per ton below these figures. It appears that an agreement has been arrived at between the English makers with regard to the Scottish market, and they are maintaining a very firm attitude.

Coke.

Business is very quiet in the coke market, and will remain so until a greater degree of activity is witnessed in the foundry industry. Durham brands of foundry coke are quoted at 36s. 6d. to 38s., while Welsh coke varies from 30s. to 46s., according to quality, delivered in the Birmingham area.

Steel.

Rather brighter conditions have ruled in the steel market of late, and more interest has been shown by buyers on home and overseas account, according to the official report of the London Iron and Steel Exchange. There has been little evidence this year of the usual spring demand, and the improvement may be the beginning of this delayed movement. Business in the semi-finished steel department is expanding slowly, and, although occasionally transactions in foreign material are reported, these are comparatively few, and consumers' requirements are almost entirely met by British producers and from stock. Stocks in consumers' hands are now reported to be declining in several districts, and this should lead to an increased demand. Business in finished steel continues irregular, and this week there has been some competition from Continental material in the British market as a result of the decline in Continental prices and the movements of the exchange. Inquiry on export account appears to be improving, and the home market has also become rather more active.

Scrap.

In the Cleveland area the continued heavy demand for scrap iron is considerably strengthening the market. There are no sellers at below 42s. 6d. per ton for ordinary quality and 45s. for machinery metal. Light castings have been sold at 38s. per ton. There is a good demand for scrap iron in the Midlands and prices are steady. In Scotland, sellers are asking 50s. to 51s. 3d. for machinery metal, suitable for foundry use, and 46s. to 47s. 6d. for ordinary cast iron. The demand for heavy cast iron in South Wales is somewhat quieter, but quotations remain unchanged at 44s. to 45s. per ton. Good supplies of machinery scrap are available at 48s. to 50s. per ton.

Metals.

Copper.—Messrs. Brandeis, Goldschmidt & Company state in their report that "all the markets have been under the influence of political rather than economic conditions during the course of the week, and copper has been no exception to this tendency. Wall Street has shown a very weak appearance and, in sympathy with this, the standard market during the early part of the week fell to £28 3s. 9d., three months, and, although recovering temporarily in the middle of the week, relapsed again later to an even lower level. Electro was offered on the Continent at prices down to 4.99 cents c.i.f., without attracting any important business. The news from Central Europe, particularly from Germany, has been very disquieting, and as long as conditions remain so difficult it is unlikely that—despite the low price prevailing—copper will be puchased by consumers, except for their immediate requirements.

Prices have been :—

Cash.—Thursday, £27 16s. 3d. to £27 18s. 9d.; Friday, £27 8s. 9d. to £27 10s.; Monday, £27 2s. 6d. to £27 5s.; Tuesday, £27 11s. 3d. to £27 13s. 9d.; Wednesday, £28 2s. 6d. to £28 5s.

Three Months.—Thursday, £28 2s. 6d. to £28 5s.; Friday, £27 13s. 9d. to £27 15s.; Monday, £27 8s. 9d. to £27 10s.; Tuesday, £27 12s. 6d. to £28; Wednesday, £28 8s. 9d. to £28 10s.

Tin.—Messrs. Rudolf Wolff & Company state that the market "has exhibited some irregularity. Statistics published last week showed a decrease of about 1,600 tons in the total visible supply and were therefore better than had been expected. On the publication of the statistics the price sharply recovered and on Thursday last up to £149 10s. was paid for three months, but sellers coming out more freely again at the higher level easier conditions have developed. Trade demand has broadened a little here and there, the firmer tendency of the market having stimulated a better inquiry from South Wales and on the Continent, but quieter conditions prevail in America, where only a moderate business has been reported. Whilst the improving statistical position may be regarded as undoubtedly satisfactory as far as it goes, it has failed to stimulate that wider demand which would have been attracted had the general financial and economic situation not provided so much ground for depression and uncertainty; with a clearer outlook in this respect and confidence in a measure re-established the price of tin might show a more appreciable advance."

Prices of standard tin have been :—

Cash.—Thursday, £147 15s. to £147 17s. 6d.; Friday, £146 17s. 6d. to £147; Monday, £146 12s. 6d. to £146 17s. 6d.; Tuesday, £145 12s. 6d. to £145 17s. 6d.; Wednesday, £148 12s. 6d. to £148 15s.

Three Months.—Thursday, £148 7s. 6d. to £148 10s.; Friday, £147 7s. 6d. to £147 10s.; Monday, £147 7s. 6d. to £147 12s. 6d.; Tuesday, £146 5s. to £146 10s.; Wednesday, £149 to £149 5s.

Spelter.—A slightly stronger tone was witnessed towards the end of last week, the tone of the market also being strengthened by the news that the Zinc Cartel is to remain in force until July. Business has since fallen away, however, buyers being unfavourably impressed by the development of the international financial situation.

Price fluctuations :—

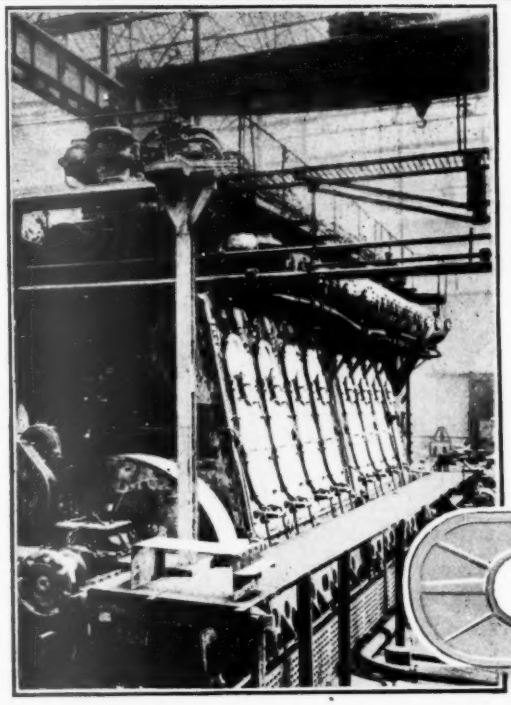
Ordinary.—Thursday, £14 2s. 6d.; Friday, £14 2s. 6d.; Monday, £14; Tuesday, £14 6s. 3d.; Wednesday, £14 11s. 3d.

Lead.—The price of this metal has fallen in accordance with the course of the other markets, but there is, nevertheless, a slightly stronger demand from consumers, both in this country and on the Continent. A more healthy tone is apparent in this market.

Daily market prices :—

Soft Foreign (Prompt).—Thursday, £10 8s. 9d.; Friday, £10 7s. 6d.; Monday, £10 5s.; Tuesday, £10 6s. 3d.; Wednesday, £10 17s. 6d.

CAST IRON FLANGED PIPES
2 in.—12 in. & CONNECTIONS. to 24 in. dia.
WE HAVE FIFTY-TWO YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.
JAMES & RONALD RITCHIE, LTD.,
Telephone : 3852 (2 Lines). MIDDLESBROUGH. Telegrams: "Ritchie, Middlesbrough."



A 4,000-h.p. Fairfield-Sulzer Diesel engine by Fairfield Engineering Co., Ltd., with "Wilmil" aluminium alloy inspection doors. The door shown at foot is by Lightalloys, Ltd.

WEIGHT REDUCTION ON BOARD SHIP . . .

From two standpoints the lightness of aluminium alloy has a monetary value to marine engineers—(1) Reduced deadweight leaves more capacity for payload. (2) Portability for massive inspection doors and other equipment saves in man-handling.

The special aluminium alloys available for marine castings are highly resistant to corrosion.

B.A.C. Aluminium Foundry Data is available to buyers and foundrymen.

F.T.J. 9.3.33.

ALUMINIUM AND LIGHT ALLOYS

THE BRITISH ALUMINIUM Co LTD.

ADELAIDE HOUSE, KING WILLIAM STREET, LONDON. E.C.4.

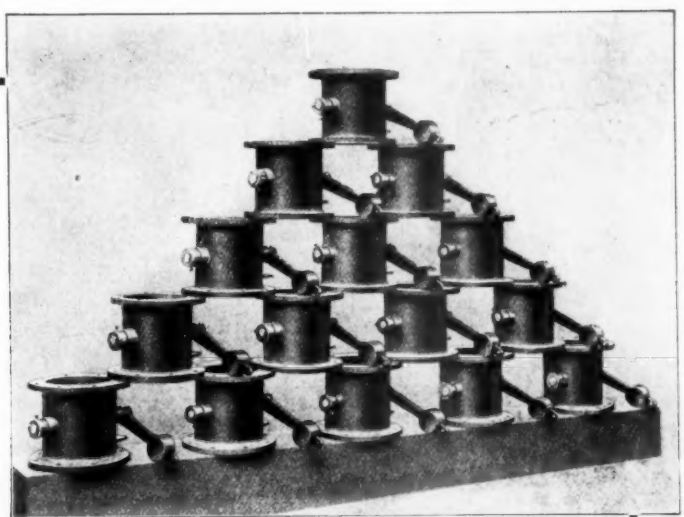
TELEPHONE: MANSION HOUSE 5561 & 8074 (5 LINES) TELEGRAMS: CRYOLITE, BILGATE, LONDON.

TRADE SIROCCO MARK

products for DUNSTON Power Station

72

DAVIDSON "D" TYPE patent centrifugal FLUE DUST COLLECTORS



These gravity operated valves are for use with some of the 72 Davidson "D" type patent Flue Dust Collectors now in course of installation at the new Dunston Power Station, Newcastle-on-Tyne.

DAVIDSON & CO. LTD.

Sirocco Engineering Works,

BELFAST.

LONDON, MANCHESTER, BIRMINGHAM, NEWCASTLE, CARDIFF, BRISTOL, GLASGOW.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	28	2	6
Three months	28	8	9
Electrolytic	32	0	0
Tough	29	0	0
Best selected	29	10	0
Sheets	59	0	0
India	39	5	0
Wire bars	32	0	0
Do., April	32	2	6
Do., May	32	5	0
Ingot bars	32	0	0
H.C. wire rods	34	15	0
Off. av. cash, February	28	10	6¾
Do., 3 mths., February	28	15	4¼
Do., Sttlmnt., February	28	10	6
Do., Electro, February	32	14	9½
Do., B.S., February	31	3	9
Do., wire bars, February	32	18	6
Solid drawn tubes			9½d.
Brazed tubes			9½d.
Wire			6½d.

BRASS.

Solid drawn tubes	8¾d.
Brazed tubes	10¾d.
Rods, drawn	7⅞d.
Rods, extd. or rlld.	4¾d.
Sheets to 10 w.g.	7⅜d.
Wire	7½d.
Rolled metal	6⅞d.
Yellow metal rods	4¼d.
Do. 4 × 4 Squares	5½d.
Do. 4 × 3 Sheets	5¼d.

TIN.

	£	s.	d.
Standard cash	148	12	6
Three months	149	0	0
English	149	15	0
Bars	149	5	0
Straits	151	7	6
Australian	149	2	6
Eastern	150	10	0
Banca	151	12	6
Off. av. cash, February	148	12	7½
Do., 3 mths., February	149	1	2¼
Do., Sttlmt., February	148	12	6

SPELTER.

	£	s.	d.
Ordinary	14	11	3
Remelted	13	15	0
Hard	11	15	0
Electro 99.9	16	15	0
English	15	0	0
India	13	15	0
Zinc dust	20	15	0
Zinc ashes	2	5	0
Off. aver., February	13	19	10⅛
Aver. spot, February	13	17	3¾

LEAD.

	£	s.	d.
Soft foreign ppt.	10	17	6
Empire	10	13	9
English	12	5	0
Off. average, February	10	11	6
Average spot, February	10	8	7½

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	24	0	0
Do., V.M. ex-whse.	23	0	0
Rods	26	0	0
Boiler plates	22	0	0
Battery plates		—	

ANTIMONY.

English	37	10	0 to	42	10	0
Chinese				27	15	0
Crude					—	

QUICKSILVER.

Quicksilver	—

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro silicon—			
25%	8	0	0
45/50%	13	15	0
75%	19	10	0
Ferro-vanadium—			
35/50%	12/8 lb. Va.		
Ferro-molybdenum—			
70/75% carbon-free	6/3 per lb. of Mo.		
Ferro-titanium—			
23/25% carbon-free	10d. lb.		
Ferro-phosphorus, 20/25%	£17	10	6
Ferro-tungsten—			
80/85%	1/7½ lb.		
Tungsten metal powder—			
98/99%	1/10½ lb.		
Ferro-chrome—			
2/4% car.	£29	5	0
4/6% car.	£23	7	6
6/8% car.	£22	15	0
8/10% car.	£22	10	0
Ferro-chrome—			
Max. 2% car.	£34	10	6
Max. 1% car.	£36	10	0
Max. 0.70% car.	£40	2	6
70% carbon-free	1/– lb.		
Nickel—99.5/100%	£245 to £250		
"F" nickel shot	£220	0	0
Ferro-cobalt	7/3 lb.		
Aluminium 98/99%	£100	0	0
Metallic chromium—			
96/98%	2/9 lb.		
Ferro-manganese (net)—			
76/80% loose	£10 15 0 to £11 5 0		
76/80% packed	£11 15 0 to £12 5 0		
76/80% export	(nom.) £9 15 0		
Metallic manganese—			
94/96% carbon-free	1/4 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten 2s. 0d.
Finished bars, 18% tungsten 2s. 9d.
Per lb. net, d/d buyers' works.

Extras—
Rounds and squares, 3 in. and over 4d. lb.
Rounds and squares, under ½ in. to ⅛ in. 3d. lb.
Do., under ⅛ in. to ⅛ in. 1/– lb.
Flats, ½ in. × ⅛ in. to under 1 in. × ⅜ in. 3d. lb.
Do., under ⅛ in. × ⅛ in. 1/– lb.
Bevels of approved sizes and sections 6d. lb.
Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel	2	4	0 to	2	5	0
Bundled steel and shrngs.	1	17	6 to	2	1	6
Mixed iron and steel	2	0	0 to	2	1	6
Heavy cast iron	2	4	0 to	2	5	0
Good machinery	2	8	0 to	2	10	0
Cleveland—						
Heavy steel				2	5	0
Steel turnings				1	12	6
Cast-iron borings				1	3	6
Heavy forge				2	10	0
W.I. piling scrap				2	2	6
Cast-iron scrap	2	2	6 to	2	5	0
Midlands—						
Light cast-iron scrap	1	18	0 to	2	0	0
Heavy wrought iron				2	5	0
Steel turnings, f.o.r.				1	5	6
Scotland—						
Heavy steel	1	18	6 to	2	0	0
Ordinary cast iron	2	6	0 to	2	7	6
Engineers' turnings				1	11	6
Cast-iron borings	1	11	6 to	1	12	6
Wrought-iron piling				2	3	0
Heavy machinery	2	10	0 to	2	11	0

London—Merchants' buying prices delivered yard.

Copper (clean)	21	0	0
Brass	16	0	0
Lead (less usual draft)	9	0	0
Tea lead	7	10	0
Zinc	8	0	0
New aluminium cuttings	74	0	0
Braziery copper	19	0	0
Gunmetal	18	0	0
Hollow pewter	80	0	0
Shaped black pewter	60	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	65/–
Foundry No. 3	62/6
,, at Falkirk	59/9
,, at Glasgow	62/9
Foundry No. 4	61/6
Forge No. 4	61/6
Hematite No. 1, f.o.t.	59/6
Hematite M/Nos., f.o.t.	59/–
N.W. Coast—	
Hem. M/Nos. d/d Glas.	68/6
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/–
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	62/–
,, No. 3 fdry.	66/–
Northants forge	58/6
,, fdry. No. 3	62/6
,, fdry. No. 1	65/6
Derbyshire forge	62/–
,, fdry. No. 3	66/–
,, fdry. No. 1	69/–
Scotland—	
Foundry No. 1	67/6
,, No. 3	65/–
Hem. M/Nos. d/d	66/–
Sheffield (d/d district)—	
Derby forge	59/6
,, fdry. No. 3	63/6
Lincs forge	59/6
,, fdry. No. 3	63/6
E.C. hematite	73/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	67/–
Staffs fdry. No. 3	67/–
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/–
Dalzell, No. 3 (special)	102/6 to 105/–
Glengarnock, No. 3	82/–
Clyde, No. 3	82/–
Monkland, No. 3	82/–
Summerlee, No. 3	82/–
Eglinton, No. 3	82/–
Gartsherrie, No. 3	82/–
Shotts, No. 3	82/–

FINISHED IRON AND STEEL.

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	9	0	0 to	9	15	0
Nut and bolt iron	7	15	0 to	8	0	0
Hoops	10	10	0 to	12	0	0
Marked bars (Staffs) f.o.t.				12	0	0
Gas strip	10	10	0 to	12	0	0
Bolts and nuts, ¾ in. × 4 in.				12	10	0
Steel—						
Plates, ship, etc.	8	15	0 to	8	17	6
Boiler plts.	8	0	0 to	9	0	0
Chequer plts.				10	7	6
Angles				8	7	6
Tees				9	7	6
Joists				8	15	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ⅜ in. (Untested)	6	15	0 & up.			
Flats—8 in. wide and over				8	12	6
,, under 8 in. and over 5 in.				8	17	6
Rails, heavy	8	5	0 to	8	10	0
Fishplates				12	0	0
Hoops (Staffs)	9	10	0 & up.			
Black sheets, 24g. (10-t. lots)				9	10	0
Galv. cor. shts. ,,				11	15	0
Galv. flat shts. ,,				12	5	0
Galv. fencing wire, 8g. plain				14	0	0
Billets, soft	5	0	0 to	5	7	6
Billets, hard	6	12	6 to	7	2	6
Sheet bars	4	15	0 to	5	2	6
Tin bars				4	15	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	10½d.
Sheet to 10 w.g.	11½d.
Wire	11½d.
Rods	10½d.
Tubes	15d.
Castings	12½d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	13.34
No. 2 foundry, Valley	14.50
No. 2 foundry, Birm.	11.00
Basic	15.39
Bessemer	16.89
Malleable	16.39
Grey forge	16.39
Ferro-mang. 80%, seaboard	68.00
O.-h. rails, h'y, at mill	40.00
Billets	26.00
Sheet bars	26.00
Wire rods	35.00
	Cents.
Iron bars, Phila.	1.86
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Steel hoops	1.55
Sheets, black, No. 24	2.00
Sheets, galv., No. 24	2.50
Wire nails	1.85
Plain wire	2.10
Barbed wire, galv.	2.35
Tinplates, 100-lb. box	$4.25

COKE (at ovens).

Welsh foundry	20/– to 25/–
,, furnace	16/– to 17/–
Durham and Northumberland—	
,, foundry	21/– to 25/–
,, furnace	13/3
Midlands, foundry	—
,, furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box		16/–
,,	28×20 ,,		32/–
,,	20×10 ,,		23/–
,,	18¾×14 ,,		16/7½
C.W.	20×14 ,,		14/– to 14/6
,,	28×20 ,,		29/3 to 29/6
,,	20×10 ,,		19/10
,,	18¾×14 ,,		14/–

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6	0	0 to	£7	0	0
Bars-hammered, basis	£16	10	0 to	£17	0	0
Bars and nail-rods, rolled, basis	£15	17	6 to	£16	5	0
Blooms	£10	0	0 to	£12	0	0
Keg steel	£32	0	0 to	£33	0	0
Faggot steel	£18	0	0 to	£23	0	0
Bars and rods dead soft, st'l	£10	0	0 to	£12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.	
Mar.	2 ..	27	16	3	dec. 3/9
,,	3 ..	27	8	9	,, 7/6
,,	6 ..	27	2	6	,, 6/3
,,	7 ..	27	11	3	inc. 8/9
,,	8 ..	28	2	6	,, 11/3

Electrolytic Copper.

		£	s.	d.	
Mar.	2 ..	31	15	0	No change
,,	3 ..	31	10	0	dec. 5/-
,,	6 ..	30	15	0	,, 15/-
,,	7 ..	31	0	0	inc. 5/-
,,	8 ..	32	0	0	,, 20/-

Standard Tin (cash).

		£	s.	d.		
Mar.	2 ..	147	15	0	dec.	20/-
,,	3 ..	146	17	6	,,	17/6
,,	6 ..	146	12	6	,,	5/-
,,	7 ..	145	12	6	,,	20/-
,,	8 ..	148	12	6	inc.	60/-

Tin (English ingots).

		£	s.	d.		
Mar.	2 ..	148	15	0	dec.	20/-
,,	3 ..	148	0	0	,,	15/-
,,	6 ..	147	15	0	,,	5/-
,,	7 ..	146	15	0	,,	20/-
,,	8 ..	149	15	0	inc.	60/-

Spelter (ordinary).

		£	s.	d.		
Mar.	2 ..	14	2	6	dec.	2/6
,,	3 ..	14	2	6	No change	
,,	6 ..	14	0	0	dec.	2/6
,,	7 ..	14	6	3	inc.	6/3
,,	8 ..	14	11	3	,,	5/-

Spelter (Electro, 99.9 per cent.).

		£	s.	d.	
Mar.	2 ..	16	12	6	No change
,,	3 ..	16	10	0	dec. 2/6
,,	6 ..	16	10	0	No change
,,	7 ..	16	15	0	inc. 5/-
,,	8 ..	16	15	0	No change

Zinc Sheets (English).

		£	s.	d.		
Mar.	2 ..	24	0	0	No change	
,,	3 ..	24	0	0	,,	,,
,,	6 ..	24	0	0	,,	,,
,,	7 ..	24	0	0	,,	,,
,,	8 ..	24	0	0	,,	,,

Lead (English).

		£	s.	d.		
Mar.	2 ..	12	0	0	No change	
,,	3 ..	12	0	0	,,	,,
,,	6 ..	11	15	0	dec.	5/-
,,	7 ..	11	15	0	No change	
,,	8 ..	12	5	0	inc.	10/-

AVERAGE MONTHLY PRICES OF STEEL BOILER PLATES IN ENGLAND.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1896	6 0 0	6 0 6	6 2 6	6 2 6	6 2 6	6 0 0	6 0 0	6 0 0	6 0 0	6 2 6	6 10 0	6 10 0	6 2 6
1897	6 10 0	6 10 0	6 10 0	6 7 6	6 2 6	6 5 0	6 0 0	6 0 0	6 0 0	6 0 0	6 7 6	6 10 0	6 5 5
1898	6 10 0	6 8 9	6 8 9	6 10 0	6 15 0	6 18 9	6 17 6	6 17 6	7 2 6	6 15 0	7 0 0	7 5 0	6 15 8½
1899	7 5 0	8 0 0	8 2 6	8 2 6	8 5 0	8 5 0	8 12 6	8 12 6	8 15 0	8 15 0	9 2 6	9 5 0	8 17 8½
1900	9 5 0	9 5 0	9 7 6	9 10 0	9 12 6	10 5 0	10 5 0	10 5 0	10 5 0	10 0 0	9 15 0	9 15 0	9 15 10
1901	9 5 0	8 15 0	8 15 0	8 10 0	8 10 0	7 10 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	8 3 11
1902	7 7 6	7 0 0	7 12 6	7 12 6	7 12 6	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 9 7
1903	7 10 0	7 10 0	7 15 0	7 5 0	7 5 0	7 5 0	7 5 0	7 0 0	7 0 0	7 0 0	7 0 0	6 17 6	7 3 11½
1904	6 12 6	6 15 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	6 18 11½
1905	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 10 0	7 5 0	8 0 0	8 0 0	7 1 3
1906	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 10 0	8 0 10
1907	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 0 0	8 0 0	8 8 4
1908	7 10 0	7 10 0	7 10 0	7 5 0	7 5 0	7 5 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 3 9
1909	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	6 15 0	6 15 0	6 15 0	7 0 0	7 0 0	7 0 0	7 0 0	6 18 9
1910	7 0 0	7 0 0	7 1 3	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 10 0	7 10 0	7 10 0	7 5 1
1911	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 14 0	7 10 4
1912	7 18 9	8 0 0	8 0 0	8 7 6	8 10 0	8 10 0	8 10 0	8 15 0	8 16 3	9 0 0	9 2 0	9 5 0	8 11 2½
1913	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	8 19 0	8 15 0	8 5 0	7 15 0	7 15 0	8 17 0
1914	7 15 0	7 15 0	7 15 0	7 13 9	7 10 6	7 5 0	7 0 0	8 0 0	8 2 6	8 5 0	8 5 0	8 5 0	7 15 11½
1915	8 14 0	9 10 0	9 17 6	10 10 0	10 10 0	11 0 0	11 0 0	11 0 0	11 0 0	11 4 0	12 0 0	13 0 0	10 15 5½
1916	13 0 0	13 0 0	13 0 0	12 15 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 12 11
1917	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0
1918	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0
1919	13 0 0	15 0 0	15 0 0	15 0 0	19 5 0	19 17 6	21 0 0	21 10 0	21 10 0	21 10 0	21 15 0	23 10 0	18 9 9
1920	26 0 0	28 0 0	28 5 0	28 10 0	29 5 0	30 0 0	30 0 0	30 0 0	30 10 0	31 0 0	31 0 0	31 0 0	29 9 2
1921	30 5 0	29 0 0	25 0 0	25 0 0	25 0 0	23 0 0	21 0 0	20 10 0	19 0 0	17 10 0	16 0 0	14 16 0	22 1 9
1922	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	13 1 8	13 10 0	12 15 0	12 10 0	12 10 0	12 10 0	12 6 0	13 10 9
1923	12 8 9	13 6 0	14 0 0	14 0 0	14 0 0	13 12 6	13 0 0	13 0 0	13 0 0	13 0 0	13 0 0	13 10 0	13 9 1½
1924	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	14 0 0	14 0 0	13 11 0	13 5 0	13 5 0	13 10 11
1925	13 5 0	13 5 0	13 5 0	13 1 0	12 15 0	12 15 0	12 15 0	12 15 0	12 7 6	11 14 0	11 10 0	11 10 0	12 11 5½
1926	11 10 0	11 10 0	11 10 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 6 3
1927	11 5 0	11 5 0	11 5 0	11 2 6	11 0 0	11 0 0	11 0 0	11 0 0	10 16 0	10 10 0	10 10 0	10 10 0	10 19 0½
1928	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0
1929	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 5 0	10 1 3	10 1 3	10 1 3	10 1 7	10 8 8½
1930	10 2 9	10 3 5½	10 3 9	10 3 9	10 3 6	10 2 6	10 2 6	10 2 6	10 2 2½	9 19 6	9 16 3	9 16 3	10 1 6½
1931	9 15 0	9 15 0	9 15 0	9 10 11	9 6 9	9 5 0	9 7 0	9 7 9½	9 8 9	9 5 9	9 5 6	9 9 6	9 9 4
1932	9 5 0	9 2 6	8 18 6	8 17 6	8 16 6½	8 16 3	8 16 3	8 16 3	8 16 3	8 16 3	8 16 3	8 16 3	8 17 10
1933	8 10 0	8 10 0	—	—	—	—	—	—	—	—	—	—	—

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.

ZETLAND ROAD, MIDDLESBROUGH.

XUM

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

FOUNDRY Manager (Iron and Bronze), of wide experience in high-grade work, seeks engagement. Thoroughly capable of taking entire charge of foundries and patternshop.—Box 354. Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

FOREMAN required—competent, energetic, good timekeeper and experienced in controlling men—to supervise production of cast-iron foundry manufacturing ingot moulds and varied range of general engineering castings.—Write, stating age, previous experience, and salary required, Box 358. Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY Foreman required to control production of high-grade castings for gas appliances. Must possess first-class practical, technical and metallurgical experience, including modern methods pertaining to machine, plate and floor moulding, also cupola practice. Applications must include full details regarding training and experience, age, and salary required.—To: The Parkinson Stove Company, Limited, Stechford.

FOUNDRY Foreman wanted, keen, and with wide experience in the manufacture of cast-iron chilled and grain rolls. Consideration will only be extended to applicants who state fully their experience.—Write, stating age, salary required, Box 360, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of The Foundry Trade Journal.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

FOUNDRY Manager, with considerable experience with well-known and high-class firms producing highest quality of castings, is open for new engagement. Capable of taking full charge; highest credentials. (208)

POSITION required as Foreman in iron or steel foundries. Has held position as Foreman in first-class steel foundry, and also had good iron-foundry experience in general castings, high-class repetition work, motor cylinders, etc.; accustomed to quoting; good cupola practice. (209)

FOUNDRY Foreman desires re-engagement. Sound technical and practical training. Experience marine, railway and textile, machine and plate moulding. Thoroughly reliable; take complete charge or willing to act as assistant. Will go anywhere. (210)

AGENCY.

ENGINEER, with excellent connection amongst foundries in London and the South of England, requires additional agency.—Box 342, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

PROPERTY.

MAGNIFICENT

11 ACRES WORKS SITE.

SHEFFIELD.

145,000 Sq. Ft. of Shops.

SIDING CONNECTIONS

with L.M. & S. and L. & N.E. Rlys.

WELL-BUILT & COMMODIOUS OFFICES

Will Sell whole or in lots to suit customers or Let on favourable terms. Unique opportunity for Manufacturers.

Apply—

THOS. W. WARD, LTD.,

ALBION WORKS, SHEFFIELD.

PUBLICATION

RYLAND'S DIRECTORY of the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades. 1932 edition. Price 42s., bound in cloth.—Industrial Newspapers, Ltd., 49, Wellington Street, Strand, London, W.C.2.

MACHINERY.

FOR Sale.—Dorman Die Casting Machine, gas-fired, £16 10s. Evans Moulding Machine, £3 15s. Iron Grinder on C.I. stand, F. and L. and overhead S. gear, £2 15s. Salter's ½-ton Spring Balance Scales, 35s. 2-h.p. G.E.C. 210-v., 3-p., 50-cycle Motor with Keith Blower, £7 10s. 5-ton Western Block, 55s. Crucibles, Foundry Tools, or reasonable offer.—12, Heath Street, Hampstead, N.W. (Tel. 4903).

SAND BLASTING PLANTS FOR SALE

Tilghman Sand Blast Room, 6 ft. x 6 ft. x 8 ft. high.

Tilghman Rotary Barrel, 36 in. x 30 in.

Tilghman Rotary Double Barrel Plant, barrels 24 in. x 20 in.

Tilghman 4-ft. 6-in. x 3-ft. Cabinet Plant.

Tilghman 30-in. dia. Cabinet Plant.

Jackman Rotary Barrel, 30 in. x 24 in.

Each Plant complete with Sand Apparatus, Air Compressor and Exhaust Fan.

Large stock of FOUNDRY PLANT at LOW PRICES.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.

215, BARCLAY ROAD, WARLEY,

Nr. Birmingham.

'Phone: Bearwood 1103.

THOS. W. WARD, LTD.

PUMP, "Worthington" Hori. Duplex, 10" x 7" x 10", cap. 9,000 galls. per hr.

GENERATING SET, 15 kw., Petrol-dr., 230 volts, 1,000 revs.

PUMP, Hori. geared, 3-throw, Motor-dr., cap. 25,000 galls. per hr. against 600' head.

"International" and "Dey" TIME RECORDERS.

Write for "Albion" Catalogue.

'Grams: "Forward, Sheffield."

'Phone: 23001 (10 lines).

ALBION WORKS, SHEFFIELD.

MISCELLANEOUS.

THE BEST STRAW ROPES

for foundry work are made by

SKELMERSDALE STRAW ROPE WORKS

at Skelmersdale, Lancs.

Strong, evenly-spun ropes at lowest prices.

STRAW ROPES.—We are the only manufacturers in Hull. We quote by guaranteed measure or by weight.—William Olsen, Limited, Cogan Street, Hull.

'Phone: 287 SLOUGH

HAND MOULDING MACHINES

Six Standard "Adaptable" machines £12 each

Two "LARGE" Adaptables (take 30"×30") ... ... £15 each

24"×30" Darling & Sellars turnover £15

Two 18"×16" Coventry HEADRAM squeezers ... ... £18 each

PNEUMATIC MACHINES

14"×16" Tabor split pattern ...	£30
18"×18" Tabor split pattern ...	£40
30"×20" Macdonald jolt rollover...	£60
20"×16" Macdonald jolt rollover...	£40

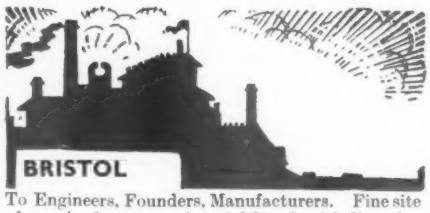
AIR COMPRESSORS
ALL SIZES IN STOCK.

Every Machine overhauled and retested.

BUY FROM ME AND SAVE MONEY!

ALEX. HAMMOND, *Foundry Machinery Merchant,*

14, AUSTRALIA ROAD, SLOUGH



To Engineers, Founders, Manufacturers. Fine site of nearly 3 acres on Arterial Road with Foundry and Workshops and own Rail Sidings into premises. Modern Offices, Warehouse and Workrooms. Central Heating.

CHARLES A. TRICKS & SON.
Auctioneers,
ST. NICHOLAS STREET, BRISTOL.

FOUNDRY REQUISITES

SPECIALITIES, REFRACTORIES, EQUIPMENT

Etc.,		Etc.
Core Oils	Fluxes	Parting Powders
Compounds	for	Plumbagoes
Binders	Iron	Graphites
Core Gum	Steel	Coal Dust
Chaplets	Brass	Blackings
and Studs	Bronze	Ladles, Bellows
Moulders' Pins	Gunmetal	Sieves, Riddles
Sprigs, Nails	Aluminium	Wire Brushes
Core Wire	Etc., Etc.,	Barrows, Shovels

Refractories of every description

EVERYTHING IN FOUNDRY EQUIPMENT

BRITISH FOUNDRY UNITS

Incorporating LTD.

Foundry Materials & Products Dept. of BEECROFT & PARTNERS, LTD.

Incorporating

Foundry Requisites & Chesterfield Blacking Works of J. & J. DYSON, LTD.

RETORT WORKS,
CHESTERFIELD.

Telegrams: RETORT, CHESTERFIELD. Telephone: 2719 CHESTERFIELD

RYLAND'S DIRECTORY

[2,200 pages 8¼" × 5¼"].

The standard work of reference covering the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades.

1932 EDITION.

ORDER YOUR COPY NOW.

PRICE **42**/- *BOUND IN CLOTH.*

INDUSTRIAL NEWSPAPERS, Ltd.
49, Wellington St., Strand, London, W.C.2.

Telephone: Temple Bar 3951 (5 lines).